Residential, Commercial and Industrial Sector Technical Work Group Policy Option Recommendations

Summary List of Policy Option Recommendations

	Policy Option	GHG Reductions ($MMtCO_2e$) 2012	GHG Reductions ($MMtCO_2e$) 2020	GHG Reductions ($MMtCO_2e$) Total 2008 2020	Net Present Value 2008–2020* (Million $)	Cost-Effectiveness ($/tCO_2e$)
RCI-1	Demand-Side Management (DSM) Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil	0.6	2.8	15.6	-$498	-$32
RCI-2	Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds)	*Not quantified separately.*				
RCI-3	Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors	0.5	2.0	11.5	-$193	-$17
RCI-4	Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations	1.0	4.2	24.2	-$529	-$22
RCI-5	Rate structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues)	0.1	0.4	2.9	-$226	-$78
RCI-6	Provide Incentives to Promote and Reduction of Barriers to Implementation of Renewable Energy Systems	*Quantified in coordination with ES TWG.*				
RCI-7	Provide Incentives and Resources to Promote and Reduction of Barriers to Implementation of Combined Heat and Power (CHP, or "cogeneration") and Waste Heat Capture, Including Net-metering for Combined Heat and Power	*Quantified in coordination with ES TWG.*				
RCI-8	Consumer Education Programs, Including Labeling of Embodied Life-cycle Energy and Carbon Content of Products and Buildings	*Not quantified.*				
RCI-9	Identification of GHG Emissions Impacts and Measures to Avoid, Minimize, or Mitigate them for Projects Requiring	*Not quantified.*				

	Policy Option	GHG Reductions ($MMtCO_2e$)			Net Present Value 2008–2020* (Million $)	Cost-Effective-ness ($/$tCO_2e$)
		2012	2020	Total 2008 2020		
	Government Review, and in Designing Government Rules and Regulations					
RCI-10	More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design	1.7	3.2	26.6	-$1075	-$40
RCI-11	Policies and/or Programs Specifically Targeting Non-energy GHG Emissions	0.3	1.5	7.8	$5	$1
	Policy Option Total After Adjusting for Overlaps**	**2.0**	**7.0**	**42.2**	**-$878**	**-$21**
	Reductions From Recent Actions***					
	Existing Gas Utility DSM Spending (RCI-1)	0.1	0.2	1.7		
	State green buildings--electricity savings	0.04	0.1	0.7		
	State green buildings--gas savings	0.03	0.1	0.6		
	Building Codes--electricity savings	0.1	0.3	2.3		
	Building Codes--gas savings	0.1	0.2	2.0		
	Appliance Efficiency Standards--electricity savings	0.3	0.5	4.4		
	Appliance Efficiency Standards--gas savings	0.05	0.1	0.7		
	I-937 Load Goals--electricity savings	1.8	3.9	30.7		
	Total of Recent Actions	**2.6**	**5.4**	**43.1**		
	Sector Total Plus Recent Actions	**4.6**	**12.4**	**85.4**		

* All costs are reported in 2006 constant dollars, net present value is calculated using a 5% real discount rate. For more information on quantification methods, see http://www.ecy.wa.gov/climatechange/CATdocs/100407Policy_Option_Quantification_Methods.pdf.

****** Note that the emissions reduction and cost estimates shown for each individual option presume that each option is implemented alone. Many options interact extensively, as they target the reduction of energy use or emissions from the same sources. Therefore, if multiple options are implemented, the results will not simply be the sum of each individual option result. After individual option assessments were complete, a "combined policies" assessment was conducted to estimate total emission reductions, and to capture the overlaps among policies that are reported here.

*** For a discussion of recent actions (I-937, building codes, efficiency standards, etc.), see the memo "Contribution of Recent Actions to Washington State GHG Mitigation" on the CAT website. The estimates in this memo has been updated as part of the combined policies assessment noted above.

Note: Negative values in the Net Present Value and the Cost-Effectiveness columns represent net cost **savings** associated with the options. Also note that totals in some columns may not add to the totals shown due to rounding.

RCI-1 Demand-Side Management (DSM), Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil

Mitigation Option Description

This policy is designed to use a number of different funding and incentive mechanisms to increase the investment in natural gas, propane (or liquefied petroleum gas—LPG), and fuel oil demand-side management programs. These DSM activities shall be designed to work in tandem with other strategies recommended by the CAT that also encourage energy efficiency gains in the residential, commercial and industrial sectors.

Mitigation Option Design

In order to implement DSM programs for natural gas and LPG/fuel-oil consumers, a number of funding and incentive mechanisms could be considered, analogs of many of which are in place for electric-sector DSM programs (including the recently enacted I-937[1]), while other mechanisms are being considered by the CAT for this and other policy options.[2] Candidate mechanisms for increasing the efficiency with which these fuels are used in the Residential, Commercial, and Industrial sectors include revising existing statutes to enable investments in energy efficiency, potentially including not only investments that are now cost-effective on the basis of fuel costs alone, but also eligible programs that are cost-effective when the value of avoided GHG emissions are considered.

Key elements of this option follow. See the "Implementation Mechanisms" section below for additional possible tools for achieving the goals of this option:

- I-937-like requirements for gas utilities to acquire all cost-effective energy efficiency; Initiative 937 requires that "Each qualifying [electric] utility shall pursue all available conservation that is cost-effective, reliable, and feasible."
- For propane and fuel oil consumers, which are served largely by local distributors (and thus are part of a fundamentally different market than gas consumers) a surcharge and/or incentive fund could be established to fund DSM activities.
- Requirements, surcharges and/or funds to provide incentives for natural gas customers not purchasing gas from utilities (including large-volume industrial customers, for example) to also acquire all cost-effective energy efficiency.
- A program such as Oregon's Business Energy Tax Credits system could be a useful tool to make more efficient use of natural gas, propane, and fuel oil.

---

[1] Initiative 937, "The Energy Independence Act", "… requires large utilities to obtain fifteen percent of their electricity from new renewable resources such as solar and wind by 2020 and undertake cost-effective energy conservation." Text of the initiative can be found at http://www.secstate.wa.gov/elections/initiatives/text/i937.pdf.

[2] This option does not explicitly address electricity, since it is addressed through I-937. Nonetheless, many of the suggestions below and in subsequent RCI options on policy and program implementation mechanisms, including mechanisms for financing of energy efficiency improvements, also apply to programs that save electricity, and can help to ensure the goals of I-937 are met.

- A program of low-cost loans for efficiency improvements and to encourage performance contracting, as well as other financial options such as reinvestment funds should be considered to support energy efficiency investments.
- Programs and incentives for natural gas and LPG/fuel oil efficiency improvement should be available and provide significant opportunities for efficiency improvement in all customer classes, with special emphasis on, for example, low-income customers.

Goals: Gas utilities should obtain 100 percent of cost-effective, achievable DSM savings in their service territories by the year 2020. DSM programs for LPG and fuel oil customers should be instituted so as to achieve a similar level of performance.

Timing: Apart from the overarching savings target mentioned above, the wide variety of potential implementation mechanisms will likely result in various implementation schedules for specific elements of this option.

Coverage of parties: All parties currently involved in energy policy, regulation and implementation plus the providers and users of these fuel sources.

Other: None cited.

Implementation Mechanisms

Additional potential implementation mechanisms and considerations for this option include the following:

Considerations in Program Design

- Analysis of DSM potential should be prepared to assist in directing the legislative and regulatory processes to set targets and fund programs.
- High-volume transportation gas customers (those directly served by pipeline, rather than by utilities) should be required and provided with incentives to install efficiency measures.
- Implementation/administration of efficiency programs may be carried out, as appropriate, by utility (including municipal utilities and cooperatives), state agency, or third-party actors.
- Energy end-use surveys should be used to help determine efficiency potential and target DSM activities.

Program Options

- Subsidized energy audits for homeowners, businesses, and industries
- Consumer education (see also RCI-8).
- Focus on specific market segments that are often under-served by DSM programs (low income residential, small and medium businesses).
- Energy efficiency reinvestment funds to provide capital for efficiency improvements in specific sectors

- Incentives for specific technologies, potential including (but not limited to) white roofs/rooftop gardens/ landscaping, ground-source heat pumps, lighting, water heating, plug loads, networked personal computer management, power supplies, motors, pumps, boilers, customer-side transformers, water use reduction, appliance recycling/pick-up programs and others.
- Incentives for customer-sited renewable electricity and heat including solar photovoltaic (PV), passive solar space heat, and solar water heat (SWH). (Renewable energy incentives will be covered in more detail in RCI-6 and other options.)
- Incentives to convert fossil fuel based heating systems to biomass based heating systems, while also increasing the overall system efficiency. (Fuel-switching will likely be covered in other RCI-options as well.) This could include additional use of wood and wood waste in commercial/institutional and industrial boilers, replacing fossil fuels. Here, any air quality impacts of expanded wood fuel use should be taken into consideration, as should the sustainability of wood fuel use.

Related Policies/Programs in Place

Integrated Resource Planning

In 2006, the Washington Legislature passed the Electric Utility Planning Act (ESHB 1010), requiring each consumer-owned or investor-owned electric utility, with more than 25,000 customers, to develop or update an integrated resource plan by September 2008. All plans are reviewed by CTED and must include an assessment of conservation and efficiency resources, an evaluation of renewable and nonrenewable generation, and recommendations for development of new policies and programs to obtain conservation and efficiency resources.

The Northwest Power and Conservation Council (NPCC) 5th Plan calls for reduction of 2,800 MW in electricity consumption through conservation in the next 20 years (through 2025) in the Northwest. WA State consumes about 50% of the energy in the Northwest (based on WA population compared to the rest of the region).

Type(s) of GHG Reductions

GHG benefits will result predominantly from reduced CO_2 emissions from lower levels of natural gas, fuel oil, and LPG combustion at end-user sites. Additional upstream CH_4 and CO_2 savings could occur due to incremental reduction in natural gas transmission, distribution, processing, and extraction activities.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

Preliminary Results

		Reductions ($MMtCO_2e$)*			NPV (2008–2020) $ millions	Cost-Effective-ness $/tCO_2$
	Policy	2012	2020	Cumulative Reductions (2008–2020)		
RCI-1	Demand-Side Management (DSM), Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil	0.6	2.8	15.6	-$498	-$32

Data Sources (In-hand or to be sought):

Studies of natural gas energy efficiency measures and programs in all sectors, focusing on information pertaining to the Northwest and Washington. Studies of LPG and/or heating fuel oil efficiency measures and programs, as available.

Quantification Methods:

Based on the goal of achieving 100 percent of "cost-effective, achievable DSM savings" by 2020, potential savings relative to total natural gas demand are estimated with reference to national studies, using regional or WA-based studies preferentially where available. DSM savings are modeled as being ramped in over time, starting from the first year that results are assumed to accrue. The total incremental costs of efficiency improvements are estimated using levelized cost-of-savings estimates from existing studies (national, regional, and local, as available), and the cost of providing efficiency programs are estimated from existing studies of utility investment in gas energy efficiency per unit savings achieved (or projected). For energy-efficiency programs covering other fuels (LPG, heating fuel oil), data from existing programs or planned programs elsewhere are being sought, but in the interim, cost and savings estimates from studies of natural gas programs, together with estimates of LPG and fuel-oil use by sector in WA, are being used until fuel-specific estimates are available.

Application of market factors such as user receptivity and energy management industry capacity will in part determine actual achievable potential.

(Note that energy savings and emission reductions will likely overlap considerably with other RCI options; an integrated analysis of combined impacts will be undertaken at a later stage.)

Key Assumptions (preliminary -- see Appendix for references and data sources)

- Programs apply to all natural gas sales (all sectors), and to all oil products sales in the residential and commercial sectors, but to only 15% of industrial oil products sales.
- Net levelized cost of saved energy through these programs is $4.2 per million Btu.
- Cost-effective, achievable savings taken as 20% of fuel sales pending the results of research on energy efficiency potential. Savings are phased in from 2009 through 2020, with an initial "ramp-up" of programs through 2012.

o Current gas utility DSM programs invest 0.40% of revenues in energy efficiency (estimate based on investments by gas and combined utilities in gas DSM in recent years).

o There are no substantial current DSM programs for LPG and fuel-oil consumers.

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050)

Contribution to long-term GHG emission goals is significant because these actions result in standard practices (buildings, appliances, energy using behaviors, etc.) becoming more energy-efficient over time.

Job Creation

- As with the existing DSM efforts on the electric side, expanded efforts in gas energy efficiency work to create significant numbers of jobs throughout the market from manufacturing to installation**.**
- An Urban Habitat study of "green-collar" jobs in the San Francisco Bay Area identified 22 specific sectors including energy conservation.[3, 4] There is significant potential for Washington State to take a leadership role in developing the new green, clean technology sector, and these efforts will be bolstered if barriers to conservation investment by utility partners are removed.
- According to estimates by the Clean Tech Venture Network, U.S. "green technology" investment (a subset of "environmental industry") between 2007 and 2010 will be between $14 billion and $19 billion, resulting in 400,000 to 500,000 new jobs created. This same study showed that individual states boasted anywhere from 65,800 (Connecticut) to 598,500 (California) green jobs in 2004.[5]

Reduced Fuel Import Expenditures

This option will reduce imports of petroleum and natural gas. (Quantitative estimate currently under development.)

Key Uncertainties

Uncertainties include the rate of development of the markets to achieve efficiency installations for these fuel sources, including the rate of acceptance by end users, and the development of training and education programs to expand the capacity of the energy management industry.

Additional Benefits and Costs

Replacing aging boiler systems will also provide the added benefit of creating safer buildings, and therefore decrease insurance costs. In schools statewide a focus on replacing aging boiler systems with new, more efficient systems will also lead to a better more consistent standard of comfort, therefore an improved physical learning environment.

---

[3] See "Green Collar Jobs" by Raquel Pinderhughes at: http://urbanhabitat.org/node/528.
[4] See "Community Jobs in the Green Economy" by Apollo Alliance and Urban Habitat at: http://home.apolloalliance.org/community-jobs-report/, and "D.C. Invests in Green Collar Jobs" by Bracken Hendricks of the Center for American Progress.
http://www.americanprogress.org/issues/2007/09/green_jobs.html
[5] http://www.misi-net.com/publications/9-state-synthesis-0406.pdf; Hendricks, Bracken and Benjamin Goldstein, Green Jobs for Cities: Exploring the DC Context, Center for American Progress, October 2007.
www.americanprogress.org

Feasibility Issues

DSM activities on the electric side indicate that there are no significant barriers to achieving significant savings results.
Option RCI-5 ("Rate structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues)") could help to make actions/requirements related to natural gas energy efficiency more feasible by enabling utilities to recover costs and/or by decoupling sales from revenues.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-2 Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds)

Mitigation Option Description

Targeted financial incentives and instruments, through two primary vehicles 1) business energy tax credits and 2) private/public efficiency funds, can be used as means of encouraging energy efficiency improvements that will affect the development, design, and building of both new and existing energy-using systems in the RCI sectors. This option is designed to offer financial mechanisms to support and encourage energy-efficiency improvements in both entire buildings and in stand-alone energy systems, and in both existing and new construction. As such, it serves as a key means of implementation of programs to improve energy efficiency in new and existing buildings that are described in RCI-3 and RCI-4.

Mitigation Option Design

Business energy tax credits and private/public efficiency funds are two key mechanisms for encouraging consumers in the residential, commercial, and industrial sectors, and the building sector professionals that serve them, to implement measures to improve the efficiency of new buildings and building energy systems, as well as the efficiency of existing buildings. As such, this option is designed to work in concert with options RCI-1 (DSM for gas, LPG, and propane users), RCI-3 (targeting building and community energy efficiency), and RCI-4 (focusing energy efficiency improvements in existing buildings and their operation). In addition, either or both of these mechanisms could apply to development of consumer-sited distributed renewable energy systems (see RCI-6/ES-2) and/or combined heat and power systems (see RCI-7/ES-7). Brief descriptions of the business energy tax credit and private/public efficiency fund concepts are provided below. The section that follows suggests implementation mechanisms and other details for these concepts.

Business Energy Tax Credits can provide incentives for businesses to invest in energy efficiency and/or customer-sited renewable energy systems. Washington lacks an income tax, but has business and occupations taxes (B&O taxes), typically on gross receipts, that apply to a number of different categories of businesses, and has a retail sales tax that affects most purchases made by businesses. Business energy tax credit would be applied to these types of taxes. Offering tax incentives for both new construction and retrofit projects to exceed energy codes would be a goal. Specific types of tax credits for energy-efficiency/renewable energy applications in Washington might include:

- **Energy Performance Contracting Sales Tax Exemption**: Provide an exemption from retail sales taxes (~6.5%) for those projects electing energy savings performance contracting services.
- **Superior Energy Efficiency Sales Tax Exemption**: Provide exemption from a portion of sales taxes to projects that produce buildings and other infrastructure (including, for example industrial process equipment) that have superior energy performance. This exemption would be applied both for improvements to new or existing buildings or processes, and could be applied,

for example, to sales of qualifying energy efficiency services, construction materials, and high-efficiency equipment.

- **Clean Technology Businesses B&O Credit**: Provide a B&O tax credit for businesses that deliver energy-efficiency-related services.

The overarching intent of these tax credits would be to yield a nearly neutral revenue position for the State while reducing the use of fossil fuels and their climate change impact. Tax credits applied to energy efficiency or renewable energy projects will generate additional government revenues through increased local market activity and job creation, and through re-spending of energy cost savings.

Public/Private Efficiency Funds would provide zero- or low- interest loans for energy efficiency applications in both retrofit and new construction, as well as in non-building projects such as improvements in the efficiency of industrial processes. These loans would be used to fund the remaining portions of energy efficiency projects that are not addressed by utility rebates or business energy tax credits. Zero- or no-interest loans offer project developers and their professional service providers the opportunity to construct substantially more energy efficient projects within their budgets. Loans repayments can be made from of shared savings via energy performance contracting or through other mechanisms; public and private building or other energy-using infrastructure projects may use different repayment models.

Programs of both tax credits (on sales tax and B&O taxes) and efficiency funds/loans will need to be designed carefully to make sure that the proper incentives and signals are being provided to the markets for energy-efficiency goods and services. For example, in some building markets, such as where buildings are built by developers and then sold, sales taxes exemptions, which have a direct impact on the cost of developing buildings, may be more effective than efficiency funds or low-interest loans[6].

Goals: Provide funding mechanisms sufficient to support the energy efficiency and building energy use improvement goals of RCI-1, RCI-3 and RCI-4, as well as those included in I-937 for cost-effective electricity efficiency, including attaining new building energy efficiency goals consistent with Architecture2030, LEED, or other suitable third-party-verified “green building” certification systems.
Timing: Implement funding mechanisms so to support goals above.

Coverage of parties: Commercial and industrial energy users in the private and public sectors (including those responsible for mixed-use projects), public agencies, utilities, building design and construction professionals, and lenders.

Other: None cited.

Implementation Mechanisms

Specific implementation mechanisms for **business tax credits** could include:

[6] The document, Tax Credits for Energy Efficiency and Green Buildings: Opportunities for State Action, by Elizabeth Brown, Patrick Quinlan, Harvey Sachs, and Daniel Williams of the American Council for an Energy Efficient Economy (2002), provides a summary of some of the approaches that can be used to establish incentives for energy efficiency, and the advantages and drawbacks of each. This document is available as http://www.aceee.org/pubs/e021full.pdf,

- **Energy Performance Contracting Sales Tax Exemption:** Provide an exemption from retail sales taxes (~6.5%) for those projects electing energy savings performance contracting services (RCW 39.35a) carried out on public buildings in the state, including schools, universities, community colleges, and state and local government buildings and energy savings performance contracting services in private buildings meeting the intent of RCW 39.35a. This exemption may also apply to non-building energy-efficiency projects. In a retrofit project the system energy use is clearly defined and therefore the tax credits should apply to the overall project for those projects improving energy efficiency by a minimum of 20% over the existing energy performance of a building or process.
- **Superior Energy Efficiency Sales Tax Exemption:** Sales tax incentives in the form of credits or rebates could be offered to developers for buildings whose performance substantially exceed the energy code (for example, by 20% to 30%). Since even state and local governments, as well as schools and hospitals, pay sales tax on construction costs, such an incentive would have wide application. Sales tax incentives could also be developed to provide incentives for businesses installing industrial process equipment (for which there are no applicable codes) to invest in superior energy-efficient improvements. On new construction in public and private buildings, or improvements in industrial energy-using equipment (for example), tax credits would be targeted at reducing the differential between the project costs for energy code rated systems (systems meeting or only modestly exceeding the level of energy performance required by codes) versus those systems that exceed the collective energy efficiency of the building or process by 20% over that of the energy code in effect at the time, to 1% of the total project construction costs for those projects that exceed the collective energy efficiency by 50% over that of the energy code in effect at the time, and to 2% of the total project construction costs for those projects that are net-zero buildings, meaning that they consume no more energy than they produce. Guidelines and exemptions that provide similar incentives for non-building improvements may be developed along similar lines.
- **Clean Technology Businesses B&O Credit:** To compel job creation and the growth of clean technology businesses, a B&O tax credit will be provided to those businesses that deliver energy efficiency related services, to include professional services, construction services, and highly efficient products. This B&O credit will be applied to those business revenues associated with those projects and systems that also qualify for the retail sales tax credit.

For **public/private efficiency funds**, low or no-interest loans would be used to fund the remaining portion of a project that is not addressed by utility rebates or a business energy tax credit. It is expected that this funding option would cover 30 to 70% of a total project costs. In new construction (or for new process equipment purchases), this fund would only be applicable to the differential between the project costs for energy code-rated systems versus those systems that exceed the collective energy efficiency of the building by 20% over that of the energy code in effect at the time.

The State of Washington Treasurer's program does have both a COP and LOCAL loan program that provides tax-exempt financing to municipal and state entities. And many commercial financial institutions provide a variety of equipment and system tax-exempt and commercial grade lease-back options. Tax exempt interest, even at 4%, over a 10 year loan term reduces the possible energy efficiency project scope by up to 30%. Nearly 50% of the project scope is eliminated if commercial rates of 7.5% are used to finance energy efficiency projects. Therefore, a no-interest loan program would yield significantly more energy-efficiency project scope since

public and private organizations that choose to secure outside financing will be able to direct more funds at projects improving energy efficiency versus interest charges.
For public entities, the loan obligation could be guaranteed to be paid out of the annual energy savings through an energy savings performance contracting (ESPC) model. Legislation already exists that enables an ESPC delivery in existing building, and a minor modification to RCW 39.35a would allow for the use of ESPC in new construction projects and systems. There is precedent for the national and international adoption of the ESPC model. For instance, through the Clinton Climate Initiative Energy Efficiency Building Retrofit Program (C40) an international effort is in motion to leverage ESPC programs with public/private funding to complete $5 billion in energy efficiency work internationally. For private entities the loan obligation could also be paid out of the annual energy savings through direct owner payment, micro-utility, a public/private resource management association (RMA,) a condominium association, or the energy savings performance contracting (ESPC) model.

There are different potential models for the organizations that would coordinate public/private efficiency funds, including government agencies and not-for-profit independent organizations. As noted above, these fund/loan programs—as well as the tax credit options included here, will need to be carefully designed so as to assure that their effect on the markets for energy-efficient products and services in the sectors that the programs are designed for have the desired impacts on the actors in those sectors and the markets they are designed to spur.

Related Policies/Programs in Place

Washington

In 2005, the Washington legislature enacted the Renewable Energy System Cost Recovery (RCW 82.16.110) and Tax on Manufactures or Wholesalers of Solar Energy Systems.

Other States (provided for reference)

A business energy tax credit (BETC) scheme similar to the one being successfully implemented in Oregon would serve as a good model for Washington State.

The combined spending on the BETC and RETC (residential energy tax credit) programs for 2003 totaled $30.9 million for tax credits and program administration. The effect of these tax credits combined with spending by businesses and residences taking advantage of these tax credits had the following net impacts on the Oregon economy in 2003:

- Output in Oregon’s economy increased by $42.5 million
- 182 new jobs were created in Oregon
- Oregon wages increased by $8.6 million
- Tax revenues for state and local government increased by $2.7 million
- Oregon commercial and residential energy costs decreased by $27.9 million

From http://www.oregon.gov/ENERGY/CONS/docs/EcoNW_Study.pdf

In Oregon, the tax credit is 35 percent of the eligible project costs - the incremental cost of the system or equipment that is beyond standard practice. You take the credit over five years: 10 percent in the first and second years and 5 percent each year thereafter. If you can't take the full tax credit each year, you can carry the unused credit forward up to eight years. Those with eligible project costs of $20,000 or less may take the tax credit in one year.

Trade, business or rental property owners who pay taxes for a business site in Oregon are eligible for the tax credit. The business, its partners or its shareholders may use the credit. The applicant must own or be the contract buyer of the project (the project owner). The business must use the equipment for the project or lease it for use at another site in Oregon. A project owner also can be an Oregon non-profit organization, tribe or public entity that partners with an Oregon business or resident who has an Oregon tax liability. This can be done using the Pass-through Option. Many projects qualify. They include: Conservation, Lighting, Recycling, Alternative Fuels, Hybrid Vehicles, Rental Dwelling Weatherization, Transportation, Efficient Truck Technology, Sustainable Building. The tax credit can cover all costs directly related to the project, including equipment cost, engineering and design fees, materials, supplies and installation costs.

Tax credits can apply to retrofits, new buildings, co-generation projects, and renewable resource projects.

There are a number of schemes currently being implemented, which bring together public and private investment to encourage energy efficiency in new and old buildings. Most 'efficiency funds' are being implemented on the local/city level but could be adapted to Washington State. Taking parts of each of the schemes may be the best approach for a state-wide fund.

Using the Cambridge Energy Alliance as a model, form a independent non-profit that will assist residents, businesses and institutions and provide technical experts with figuring out what to do, finding the right people to do it and obtaining the funds to pay for energy efficiency programs, including low-interest loans that will be repaid out of documented energy savings. The fund could apply to retrofits, but also to new construction to help market driven projects achieve significantly higher levels of energy efficiency than the market will currently support. This organization could have a roster of banks that have bought into the idea that can provide low interest loans for energy efficient strategies and can be paid back through the energy savings provided by the loan (as in the case of the Clinton Climate Initiative Energy Efficiency Retrofit program). As with both the CEA and the Toronto Atmospheric Fund, start-up money for an organization of this type could come from private sources or the sale of state owned land.

Type(s) of GHG Reductions

This option would yield GHG reductions from energy efficient buildings and other energy-using systems by supporting other RCI options in reducing the overall use of electric and fossil fuels.

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

Data Sources

- It may be useful to examine the results of an earlier Washington program that included sales tax credits for renewable energy equipment purchases, though it is not known to what degree that program has been analyzed to date.

Quantification Methods

As noted above, this option supports the achievement of the energy efficiency goals of other RCI options (RCI – 1, 3, and 4) by providing additional financial mechanisms for funding of efficiency improvements. As a result, estimating the emissions savings for this option would double-count the emission savings reported for the options that RCI-2 supports. It would be helpful, however, to understand specifically the overall tax and funding implications of the above mechanisms, which could be approached by considering the impacts of different types of financial incentives on the net cost to developers of implementing energy-efficiency improvements, and if possible, estimating the general magnitude of savings that these mechanisms might encourage.

Key Assumptions:

None cited.

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050):

- Provide financing strategies beyond what the private sector market will support today for long-term benefits

Job Creation: (See also notes on Job Creation under RCI-1.)

- This option offers substantial job creation opportunities. For example, ECONorthwest documented that the 2006 Oregon Energy Trust programs (incentives) had a net effect of increasing Oregon's economic output by $37.8 million, including $11.9 million in wage income and 404 new jobs created.[7]
- Separately, ECONorthwest documented that Oregon's Energy Tax incentive program in 2006 produced 1,240 new jobs and boosted total wages by $18.6 million.8
- In a recent article, Van Jones, President of the Ella Baker Center for Human Rights, is quoted as saying "We have to retrofit a nation,". The article goes on to note "And it gets better, he says. [Energy conservation] jobs can't be outsourced. 'You can't put a building on a barge to Asia and weatherize it on the cheap.' This is about kitchen table issues: **jobs, industry, manufacturing, health, education."**[9]

Reduced Fuel Import Expenditures: Will contribute to reduced natural gas and petroleum imports by assisting with financing of energy-efficiency measures installed under other RCI options. In general, no fossil fuels are produced in Washington - all energy produced by coal, gas, propane and oil is imported - so all energy produced in part or in total by these fuels that is subject to increased efficiency will reduce fuel import expenditures.

Key Uncertainties

[7] Economic Impact Analysis of Energy Trust of Oregon Program Activities: A Report for the Energy Trust of Oregon, ECONorthwest, April 2003. www.econw.com/reports/renewableenergy6779.pdf
[8] Economic Impacts of Oregon Energy Tax Credit Programs in 2006 (BETC/RETC)) Final Report. ECONorthwest, May 30, 2007, www.oregon.gov/ENERGY/CONS/docs/EcoNW_Study.pdf.
[9] "A Green Wave Shall Lift All Boats" , Anna Fahey, 11/09/2007, http://sightline.org/daily_score/archive/2007/11/09/Van-Jones

None cited.

Additional Benefits and Costs

Consider impact on government revenues and stimulation of economy though market creation.

Feasibility Issues

The business tax exemption faces the typical challenges related to issuing tax breaks, however since this initiative would generate projects, save energy costs in public facilities, and create jobs, it is expected that a fiscal analysis (looking at all factors, not just lost tax revenue) would show a positive economic impact to the State.
Feasibility issues might lie in the public/private funding initiative that relies on public money to support private investments. This issue would need to be worked through appropriately.
Important key element of this is to create mechanisms that allow payment of loans in both retrofit and new construction through the savings from energy efficiency for both public and private entities. Also, to make sure that Washington state law allows condominium associations and other entities to guarantee the loan, as well as allowing the formation of resource management associations, ESPC, and micro-utilities at the project level.
It will be important to set the correct improvement benchmark to receive the economic incentive benefits. Having a sliding scale for greater efficiency will be very useful.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-3 Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors

Mitigation Option Description

Energy used in residential, commercial, and industrial buildings contributed roughly 20% of Washington's GHG emissions in 2005. As such, it is recommended that goals be set to encourage all new construction, both residential and commercial, to meet significantly higher energy efficiency standards in the near future. Efficiency standards should take into account all the energy required in the entire building process, including the amount of energy needed to make building materials along with the performance of the building through its use. This combination of building performance and embodied energy will produce a metric for life-cycle GHG emissions that designers and builders can look to improve upon.

Improved community planning[10] aims to create communities that are, among other attributes, livable, designed for reduced use of energy both within homes and businesses and in the transport sector, and have a reduced environmental impact relative to typical developments. Variants on the smart growth concept exist, but many call for clustering living units with easy access (often walking distance) to shops, schools, and entertainment and recreational facilities, incorporating elements of energy efficient design and renewable energy in buildings, sharing energy facilities between buildings (for example, district heating systems), and preserving open spaces.

These two concepts—significantly improved building energy performance and improved community planning—offer significant synergies for Washington. This policy suggests a combination of incentives and targets to induce the owners and developers of buildings and the communities in which they are located to produce and operate buildings and communities that produce markedly lower GHG emissions than existing buildings and communities..

Mitigation Option Design

Improved Building Design and Construction

This policy provides incentives and targets to induce the owners and developers of new and existing buildings in each of the RCI sectors to improve the efficiency with which energy and other resources are used in those buildings, along with provisions for raising targets periodically and providing resources to building industry professionals to help achieve the desired building performance. This policy can include elements to encourage the improvement and review of energy use goals over time, and to encourage flexibility in contracting arrangements to encourage integrated energy- and resource efficient design and construction. Several design standards exist that can be drawn upon to promote improved design and community planning,

[10] See, for example, http://www.epa.gov/smartgrowth/about_sg.htm for additional information about Smart Growth.

including, but not limited to, LEED[11], Architecture 2030[12], National Association of Home Builders (NAHB) Green Home Building Guidelines[13], Built Green[14], Energy Star Homes Northwest and Green Globes[15]. In the remainder of this RCI Options Description document, this group of standards and certification systems, and/or new standards and certification systems that may be developed in the future, are collectively referred to as "**third-party-verified green building certification systems**" to denote that a number of candidate systems may be applicable to a given policy, but that whatever system is used should be provide a consistent, independently adjudicated yardstick of energy efficiency performance. This policy could also include consideration of the concepts of embodied energy and "renewability" of building materials.

Improved Community Planning

Like construction of buildings and facilities themselves, land use decisions have a significant impact on regional and statewide greenhouse gas emission profiles. Research in California, NYC and elsewhere has begun to quantify this impact. California building energy researchers estimate that 10-15% of potential statewide reductions can be achieved through land use planning changes. New York City is estimating 15.6 million metric tons will be reduced through smart growth planning and design (accounting to approximately 30% of *their* total reduction strategy). Efficient community planning holds perhaps the greatest potential for future reductions of any mitigation strategy. Note that a key benefit of efficient community planning, depending on how it is carried out, can be significant reductions in transportation energy use (both passenger and goods transport). An option under consideration in the Transportation TWG, T-4, "Promote Compact and Transit-oriented Development", makes explicit recognition of this benefit.

Potential design elements for this option, addressing, separately and together, these two major concepts, include the following (see "Implementation Measures" below for further details and possible approaches):

- Create tax incentives for new and rehabilitated energy-efficient commercial and residential buildings, as well as new master planned communities.
- Tie state economic development funding to meeting building and community design standards.
- Provide incentives that encourage and promote the use of climate-friendly products in both commercial and residential buildings and building materials.
- Support and provide incentives for programs that recognize embodied energy and operational energy in the building process. This would include using informational approaches, support for certifications, and other means to support the consideration of life-cycle emissions in the building sector.

---

[11] See, for example, http://www.usgbc.org.
[12] http://www.architecture2030.org/home.html
[13] http://www.nahbrc.org/greenguidelines/
[14] Built Green is a Washington-based program that includes green building guidelines and certification. Built Green works closely with the National Association of Home Builders on the latter's programs. See, for example, http://www.builtgreen.net/checklists.html.
[15] http://www.greenglobes.com/fitup/Non-Flash/index.htm

- Develop programs for and provide education and training to consumers and in schools, as well as targeted professional training, to support the elements of this option. Professional training could include certification of building professionals as “green building certified”.
- Continue to emphasize regular improvements in building energy codes, and improvements in the enforcement of building energy codes through, for example, specific training of code inspectors in building energy code enforcement (as noted, for example, in RCI-8).
- Develop and continue to refine tools and standards to measure the GHG implications of different building approaches.
- Use a variety of policy and administrative levers to promote and provide incentives for community planning (including planning in both new and existing communities) that incorporates GHG emissions considerations, and to discourage the construction of communities that do not. Identify and modify existing laws and regulations that are obstacles to planning and developing low-emissions buildings and communities, including obstacles to making existing communities more efficient[16]. Provide local governments with analytical and policy tools to promote low-GHG-emissions community development, and encourage cooperation between jurisdictions to provide a consistent and strong approach to achieving community planning goals.
- Add climate protection as a required element of local planning under the state Growth Management Act. It is much more efficient to consider climate impacts at the level of community planning, when synergies between land use, transport, and building energy use can best be identified and addressed, than at the level of individual projects, though the latter is important as well. Therefore, emphasis on incorporating evaluation of GHG emissions impacts in comprehensive zoning processes is a critical step in achieving significant emissions reductions. This element should be integrated/coordinated with similar initiatives being considered by the Transport TWG and included in other RCI options.

Goals:

- A target percentage of GHG emissions reductions from the buildings sector should be set so as to be consistent with the Governor’s goals.
- Expand the use of climate-friendly products in building materials.
- Consider going beyond existing certification programs to Architecture 2030-level goals for new buildings, providing energy consumption performance (energy intensity) that is 50% of the regional average for each building type, or define goals as the higher levels of LEED (Gold/Platinum), higher levels of Built Green (4-Star, 5-Star), or similarly-stringent third-party-verified green building certifications in other systems of standards.
- Explicitly identify the link between GHG reductions and land use planning decisions, as well as the reduction potential and target(s) for Washington state**17**

[16] For example, by allowing/encouraging greater density of energy-efficient housing in existing neighborhoods that have nearby services accessible by foot, bicycle, or mass transit.
[17] Note that this is a category more easily measured on a regional or statewide basis than at the local government level because it includes things like “avoided sprawl” which has statewide reduction impact but may result in increased density (and emissions) locally.

Timing: As stated above, the timing of the goals should track the goals set by the Governor's Executive Order.

Coverage of parties: All builders, building material suppliers, recycled building material sellers, and home improvement stores. The aforementioned should be considered for both private and pubic construction projects.

Other: None cited.

Implementation Mechanisms

A number of potential implementation elements of this option are offered below and are grouped into several general categories:

Improved Design and Construction

General incentives and promotion:

- Create a tax incentive for new energy-efficient commercial and residential buildings, as well as new master-planned communities, using the Oregon incentives as a model. To maximize effectiveness, tax incentives should target cutting-edge, very high-efficiency technologies or practices that customers might not find otherwise. The incentives should be large enough to affect decision-making, while reporting requirements should be just stringent enough to make fraud insignificant.
- Support and provide incentives for programs that recognize embodied energy and operational energy in the building process.
- Encourage state agencies to utilize the LEED, Green Globes, Built Green, or other appropriate rating systems to promote the construction and design of energy-efficient buildings. Provide incentives for use of these systems statewide for construction in the private sector.
- Provide tax credits for construction of a green building or rehabilitation of an existing structure to green building standards.
- The state could provide incentives that encourage and promote the use of climate friendly products in both commercial and residential buildings and building materials. Promote the utilization of products harvested, manufactured and shipped within Washington State as a means to lessen the greenhouse gas emissions associated with the harvesting of natural resources, product manufacturing and the shipping of products to market.
- To provide further support for renewable energy resources beyond what I-937 requires of the state's electric utilities, encourage utilities to develop and offer (or, as appropriate, continue to offer) "green power" programs that utility customers can voluntarily subscribe to.
- Increase and extend the tax credit for PV, biomass and wind that are mandated in SR 5101 to meet the standards of other states.

Requirements for State Buildings:

- Adopt Architecture2030 goals[18], as adopted by the US Conference of Mayors, as the basis for reductions in fossil fuel use and energy efficiency performance for all buildings receiving state funding effective 2008.
- Reinforce existing state law requiring state agencies to utilize LEED, Green Globes, and/or other applicable rating systems that address greenhouse gas emissions associated with building construction and operation to promote the construction and design of energy-efficient buildings and energy-efficient remodels, require the use of increasingly stringent goals over time, and provide funding to achieve those goals. Tie State of Washington LEED (or other third-party-verified green building certification system**)** energy performance and fossil fuel use reduction goals for State of Washington buildings to the Architecture2030 goals. This will help to reduce greenhouse gas emissions, serve as a leadership example to the private sector, and promote the state's emerging clean technology industry.
- Require pre-design and programmatic studies for State of Washington-funded buildings and master plans to include resource systems analysis for energy, water, waste, recycling, transportation, and greenhouse gas emissions. Provide funding for that effort.
- Sustainably designed, built, and certified (using certification systems such as LEED, Washington Sustainable Schools, etc.) new or major renovation of public buildings should require a focus on sustainable operation in order to demonstrate the importance of sustainable operational practices in new facilities. It is truly how the facilities operate that yields the GHG savings, not only how they are built. The sustainable operation of a new facility should include, yet not be limited to, the ongoing staff training, use of documented best practices for all facility and property management activities, building re-commissioning every other year, and an ongoing measurement and verification process to track all energy usage and assess the expected and actual performance of building energy systems. Adopting LEED-EB Gold or similar third-party-verified green building certification system goals would provide for a standard approach and protocol for this post- construction focus on operations.

---

[18] As noted on its website, http://www.architecture2030.org/2030_challenge/index.html, The Architecture 2030 Challenge asks "…the global architecture and building community to adopt the following targets:

- All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.
- At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG-emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.
- The fossil fuel reduction standard for all new buildings shall be increased to:

  60% in 2010
  70% in 2015
  80% in 2020
  90% in 2025

Carbon-neutral in 2030 (using no fossil fuel GHG emitting energy to operate).

These targets may be accomplished by implementing innovative sustainable design strategies, generating on-site renewable power and/or purchasing (20% maximum) renewable energy and/or certified renewable energy credits.

Building Code Enhancement:

To ensure that the state achieves the projected energy savings and greenhouse gas reductions reflected in the CAT Inventory and Forecast, the state should evaluate and monitor energy code enforcement, and should provide funding for training and/or technical assistance for local government officials who are responsible for energy code implementation. In addition, the State Building Code Council should, as part of its regular revision cycle, include the value of carbon in the benefit cost analysis of code changes being considered, utilizing for example, the Northwest Power Planning Council's risk assessment methodology for valuing carbon.

Consideration of life-cycle emissions:

- Consideration of concepts of embodied energy in building materials, and of the "renewability" and ability to recycle building materials[19]
- Include embodied energy/carbon footprint/life cycle assessment information for building materials in green building standards such as LEED, Built Green, Energy Star, NAHB, Energy Star Homes Northwest, or Green Globes.   Ultimately, it may be desirable to move to a more unified system for assessment of life-cycle emissions and energy use that is simple and cost-effective for designers, developers and builders to apply.
- Targeting reduction of emissions from diesel engines used in new construction developments.
- Develop and support a business assistance program to help identify and achieve GHG goals and life-cycle cost analysis of buildings and building components.
- Promote measures to reduce urban "heat island" effects through integrated strategies, including green roofs, white roofs, urban forestry, natural drainage systems, and streetscape plantings.
- Include carbon footprint information/literature on materials in building supply and home improvement stores.
- Promote the state's local renewable forest products industry as a good choice in producing building products for reducing climate change impacts, relative to fossil fuel-based materials, as well as promoting the minimization of long-distance materials transportation through use of local forest industry products.

Education and training:

- Provide training and certification of building professionals in green building-related specialties. Provide suitably trained building professionals with "green building" certification so that potential purchasers and developers of green buildings can be assured that builders and designers so designated are equipped to produce green buildings. A preliminary step here would be to adapt, adopt, and/or develop a suitable set of qualifications that building professionals must meet to receive a green building certification such as in the use of the LEED and Built Green systems, or other third-party-verified green building certification systems.

---

[19] See, for example, CORRIM (Consortium for Research on Renewable Industrial Materials), Life Cycle Environmental Performance of Renewable Building Materials in the Context of Residential Construction, available from http://www.corrim.org/reports/2005/final_report/index.htm.

- Fund and require green building, green communities, energy efficiency, and carbon emissions reduction education as an addition to the state's existing K-12 environmental education requirements and in higher education curricula.
- Provide consumer and education related to green building and green communities.
- Increase private sector education to promote high performance green buildings.
- Provide incentives for building operator certification.

For tools and standards:

- Set up a clearinghouse for information on and access to software tools to calculate the impacts of energy efficiency and solar technologies for buildings, including tools for use by local governments in evaluating community design options. Encourage cooperation between local governments on community planning issues, with the ultimate goal of promoting high participation by governments across the region.
- Encourage, through promotions and incentives, private standards for green building and sustainable forest management (such as SFI, CSA, PEFC, FSC), as well as green building product certification for other building materials, such as Greenseal.
- Set a cap on consumption of energy per unit area of floor space for new buildings, and consider mechanisms to discourage the construction of residential dwellings that are larger than needed.20

Improved Community Planning

- Create incentives to encourage smart growth and support the GMA (Growth Management Act) by meeting Built Green Community certification, or LEED-ND gold level, with minimum energy and location criteria. Encourage compact and Transit-Oriented Mixed Use Development within urban growth areas that result in reduced VMT and GHG emissions while it encourages walking and biking.
- Improve planning to reduce sprawl modeled after efforts by the Center for Clean Air Policy21, the state of California, and the Institute for Local Government22 including the "California Communities Climate Action Plan" and the "California Green Community" rating tool.
- Condition approval of hook-ups to city, county and utility services upon fulfilling the guidelines set out in GHG emissions reduction plans for the area.23
- Promote "Smart Growth" and implement executive, legislative and administrative changes to enhance integrated design of communities, energy systems, and transport systems.
- Promote consideration of location as part of a building's GHG "footprint".

[20] It is recognized that defining "larger than needed" in this context will not be straightforward. The goal of this implementation mechanism is to discourage the construction of single family homes that are very large, but may have relatively few occupants, as such homes can have large total space conditioning, lighting, and other energy use, and energy use per occupant, even if they meet guidelines on energy use per unit floor area.
[21] http://www.ccap.org/
[22] http://www.cacities.org/index.jsp?zone=ilsg
[23] The intent here is not to halt development, but to make sure that development take place consistent with climate goals.

- Reinforce the importance of Growth Management and conservation easements linked to Transfer of Development Rights.
- Implement or adjust hookup fees for new developments to provide incentives for smart growth.
- Move from a State Dept. of Transportation to a State Department of Urban, Rural, and Regional Mobility to recognize various mobility needs and modes needed in the 21st Century. Charter the new department with creating a master plan to meet climate change mitigation and state mobility needs in 2020 and 2050, including transit, vehicle, freight, bicycle, and pedestrian systems. Create funding mechanisms for State support of transit, roads, waterway, bicycle, and pedestrian systems focused on encouraging compact and Transit-Oriented Mixed Use Development within urban growth areas that result in reduced VMT and GHG emissions, encouraging walking and biking.
- Mandate a new state "Complete Roads" law modeled after national best practices directing that new state-funded roads include urban design, low impact storm water design, heat island mitigation, noise reduction, bicycle, transit and pedestrian systems be included in the road design to promote livable communities and reduce emissions of greenhouse gases.
- Create and fund a new State Department of Regional and Urban Design to promote best environmental design and livable community practices, assist the new State Department of Urban, Rural, and Regional Mobility (now the State Dept. of Transportation) in context-sensitive design in urban corridors, and help local jurisdictions to implement the Growth Management Act and climate change mitigation goals through the creation of livable, sustainable communities.
- Tie disbursement of transportation funds to collaborative planning at a regional level.
- Review existing land use, building codes, and related laws and regulations, and consider modifications to laws and regulations as necessary, to assure that existing regulations and laws do not pose barriers to improved building performance and/or community planning.
- Utilize key State government leverage points to push smart land use planning approaches: including, as appropriate, SEPA, housing elements, and others.
- Require that all projects requiring government review identify GHG emission impacts and reduction options: Require that SEPA reviews quantify GHG emissions and identify measures to avoid, minimize or mitigate emissions for projects requiring government review. Include transportation, embodied, and operational emissions analysis in all State Environmental Policy Act checklists.24
- Add climate protection as a required element of local planning for comprehensive plans and zoning under the state Growth Management Act.25
- Facilitate a coordinated long-range local government planning process to better coordinate land use, transportation and economic development.
- Consider restricting financial and technical assistance to priority growth areas (as in Maryland).

[24] It is recognized that any new SEPA requirements should be designed for practical and efficient implementation by both state agencies and regulated industries.
[25] Inclusion of GHG-emissions reduction considerations under the Growth Management Act (GMA) should acknowledge existing GMA provisions that already have emissions reduction potential, and should be integrated with existing provisions so as to make compliance with all GMA requirements as straightforward as possible.

- Participate in multi-state efforts to qualify and quantify the impacts of land use on energy and environmental systems, with special emphasis on border areas where urban centers cross state lines. Participate actively in cross-borderland use and transportation planning for urban centers in areas such as Vancouver, Washington.
- Promote, remove regulatory barriers to, and provide incentives for neighborhood-based combined heat and power systems so as to encourage the use of waste heat from power generation facilities. Promote, remove regulatory barriers for, and provide incentives neighborhood heating and cooling systems.
- Support growth of localized agricultural food production and community-supported agriculture programs. Require that a percentage of all state-funded food be sourced within 100 miles of the user.

Related Policies/Programs in Place

LEED

Executive Order 05-01, directs the adoption of green building practices in the construction of new or renovated existing state buildings (>25,000 ft^2), as well as mandates a 10% reduction in State Agency energy purchases from 2003 levels by September 1, 2009 and LEED silver standards for WA public buildings.

High-Performance Public Buildings bill (Chapter 39.35D RCW), requires all new state-funded facilities over 5,000 sq. ft. to meet green building standards. Major office and higher education facility projects will be required to achieve the US Green Building Council Leadership in Energy and Environmental Design rating standards (referred to as LEED™ Silver certification). New K-12 schools will be required to meet the Washington Sustainable Schools Protocol (WSSP) or LEED certification. The Department of General Administration's Sustainable Design and Construction program oversees the construction or reconstruction of state and state funded facilities built to LEED standards. The Department of Community, Trade, and Economic Development is required to adopt sustainable building standards by July 1, 2008. The legislature prioritized the use of locally extracted and manufactured products in all state building projects. LEED requirements do not apply to affordable housing projects that receive state funding.

Several local governments offer LEED Incentive Programs. The City of Seattle's LEED Incentive program offers incentives to commercial projects based on LEED certification level achieved. Seattle's Built Green Incentive program assists with green residential single and multi-family projects. There are several tax incentives available in Washington State for solar and renewable energy products, which can be incorporated into green buildings.

Other Programs

Ecology’s Solid Waste and Financial Assistance Program is actively involved in promoting Green Building (GB) by training architects, builders, and lenders on Green Building and working with governments, communities, schools, commercial and residential sectors on GB initiatives.

Some of the activities include:

- Working with some counties to adopt GB in Solid Waste Plans.

- Maintaining the Website developed at Ecology.

CTED's Smart Growth Strategy for the 21st Century (http://smartgrowth.wa.gov)

In July 2007, the Snohomish County Executive issued an Executive Order to reduce the County's greenhouse gas emissions to 20% below 2000 levels by 2020.

As a first step toward managing their carbon footprint and community energy spending, several individual communities are now working to calculate their own GHG emissions using a variety of currently available software packages.

Type(s) of GHG Reductions

Operational Reductions: GHG benefits will result predominantly from reduced CO_2 emissions from lower levels of natural gas, fuel oil, and LPG combustion at end-user sites, and from reduced central-station fossil-fueled electricity generation caused by reduced end-user demand for electricity. Additional upstream CH_4 and CO_2 savings could occur due to incremental reduction in natural gas transmission, distribution, processing, and extraction activities.

Embodied Reductions: Reductions may also be achieved by substituting more energy intensive building materials with building materials that rely on less energy and therefore, produce fewer GHG emissions. Recommendations in this area should consider full life cycle impact, including energy required to condition/operate space following occupancy (e.g. buildings constructed of low intensity building materials may require more energy to condition based on thermal massing potential, etc.).

Transportation and Land Use Reductions: "Avoided Sprawl" through community planning measures may have significant impacts on transportation energy use and associated GHG emissions, in addition to its impacts through savings in building energy use.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

Preliminary Results

		Reductions ($MMtCO_2e$)*			NPV (2008–2020) $ millions	Cost-Effective-ness $/tCO_2$
	Policy	**2012**	**2020**	**Cumulative Reductions (2008–2020)**		
RCI-3	Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors	0.5	2.0	11.5	-$193	-$17

Please see the Appendix to this document for additional details of inputs to, data sources used for, and results of the analysis of this option.

Data Sources:

- Initial figures for the costs of building energy efficiency improvements were derived from The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association, The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report can be found at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

  Possible additional references for estimating GHG emissions reductions and associated costs include:

Improved Design & Construction:

- Architecture2030.org
- Buchanan, A.H. and S.B. Levine. 1999. Wood-based building materials and atmospheric carbon emissions. *Environmental Science and Policy*. 2: 427-437.
- Buchanan, A.H. and S.B. Levine. 1999. Wood-based building materials and atmospheric carbon emissions. *Environmental Science and Policy*. 2: 427-437.
- Eriksson, P.E. 2003. *Comparative LCA:s for wood construction and other construction methods-Energy use and GHG emissions.* A study compile on behalf of the Swedish Wood Association, now part of Swedish Forest Industries Federation, Stockholm. http://www.Svenskttra.org/pub/lca.pdf (accessed Feb 28, 2007).
- Miner, R. 2006. The 100-year method for forecasting carbon sequestration in forest products in use. *Mitigation and Adaptation Strategies for Global Change*. Published online 20 May 2006. Springerlink.
- Perez-Garcia, J., B. Lippke, D. Briggs, J. Wilson, J. Bowyer, and J. Meil. 2005. The environmental performance of renewable building materials in the context of residential construction. *Wood and Fiber Science* 37 CORRIM Special Issue: 3-17.
- Thormark, C. 2006. The effect of material choice on the total energy need and recycling potential of a building. *Building and Environment* 41:1019-1026.
- U.S. Department of Energy. 2006. Forestry Appendix to Final Technical Guidelines for Voluntary Reporting of Greenhouse Gas Program, 1605(b).

Improved Community Planning:

- "The Role of Land Use in Meeting California's Energy and Climate Change Goals."
- “Growing Cooler: The Evidence on Urban Development and Climate Change” http://sgusa.convio.net/site/DocServer/Executive_Summary.pdf?docID=4021
- Smart Growth Strategy for the 21st Century (htpp://smartgrowth.wa.gov CTED)
- A Study of Land Use, Transportation, Air Quality, and Health (LUTAQH) in King County, WA (http://www.metrokc.gov/exec/news/2006/pdf/LUTAQHupdated.pdf)
- LEED for Neighborhood Development Public Health Report, Environmental Protection Agency and the Centers for Disease Control and Prevention. (https://www.usgbc.org/ShowFile.aspx?DocumentID=1480)

- Public Transportation's Contribution to Greenhouse Gas Reduction (http://www.apta.com/research/info/online/documents/climate_change.pdf)

Quantification Methods:

Proposed Quantification Approach: This option includes two central, but not necessarily separate, approaches to improving the efficiency of and use of renewable energy in new buildings: 1) providing tools and incentives to improve the energy efficiency of and use of renewable energy in new buildings (and reduce the GHG embodied in materials for new building construction), and 2) improving community planning so that buildings in new communities, and the communities themselves, are less GHG-intensive. The analysis of these two elements sets targets for the fraction of new buildings covered by "smart growth" initiatives, then targeting a fraction of the remaining new buildings to be constructed in WA that will reach "green building" or, specifically, Architecture 2030 targets. For each of these groups—the fractions ramp in over time and the building units involved are estimated based on projections of growth in housing and commercial floor area—a level of electric and gas energy (and, if applicable and data are available, GHG emissions savings in building products) will be ascribed to the number or area of participating buildings to estimate total energy savings. Transportation energy savings from the "Smart Growth" element will be estimated in coordination with the TLU TWG. The costs of smart growth or green building relative to standards practice will be sought from existing studies, with TWG input.

(Note that energy savings and emission reductions will likely overlap considerably with other RCI options; an integrated analysis of combined impacts will be undertaken at a later stage.)

Key Assumptions:

- 50 percent of new commercial and residential buildings participate in the improved design and construction element of this option, once the program is "ramped in"
- An additional 20 percent of new commercial and residential buildings participate in the improved community planning element of this option.
- Buildings participating in the improved design and construction element of this option use, on average, 50 percent less conventional grid electricity and natural gas than the average (per residential housing unit or per unit commercial floorspace) used in Washington in 2005.
- Buildings participating in the improved community planning element of this option use, on average, 60 percent less conventional grid electricity and natural gas than the average (per residential housing unit or per unit commercial floorspace) used in Washington in 2005.
- Renovations to commercial space participate in addition to new space (renovated space is estimated at 50 percent of new space as a present "ballpark" estimate).
- Conventional grid electricity and gas inputs to buildings are reduced through a combination of use of energy efficiency improvements, solar hot water/space heat/space cooling, on-site solar PV power, biomass energy, and off-site green power purchases (beyond any supply-side renewable portfolio standards), as applicable. Fractions of these individual measures can be changed over time. Current "placeholder" estimates use efficiency improvements for the bulk of the reduction, with green power purchases use providing 10 percent of electricity use, and solar thermal (5 percent in 2012, and 7 percent in 2020), solar PV (1 percent in 2012, and 2 percent in

2020), and biomass (1 percent of electricity in all years, and (1 percent in 2012, rising 2 percent in 2020 of gas use) providing smaller fractions of total energy use reduction.

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050):

- Would have a significant impact on GHG emissions reduction over the long term, as buildings, communities and related transportation represent a significant percentage of all greenhouse gas emissions

Job Creation: (See also notes on Job Creation under RCI-1.)

- While Europe, Asia, and California are becoming global leaders in clean technology, Washington State's clean technology industry is only now emerging. The State is in a unique position in the world with significant software, biotechnology, nanotechnology, sustainable design, and agricultural industries, and capabilities at research Universities that can be aligned with this emerging creative clean technology industry throughout the state. Promoting these industries and job creation through regulatory requirements and incentives will further the economic stability of Washington State.

Reduced Fuel Import Expenditures: Reducing demand for fossil fuels through energy efficiency, smart land use planning and transportation networks, and switching to local energy and products will reduce imported fuel costs and the risks to the economy of constrained supply.

Key Uncertainties

It is uncertain whether the targets noted above for improved energy efficiency, fossil fuel reduction, smart growth land use planning linked to transit networks are sufficiently stringent as to prevent significant damage to the Washington state economy, hydroelectric energy supply, forest lands, water supplies and coastal areas due to climate change impacts.

Additional Benefits and Costs

Improvements in building energy efficiency and community design, including the reduction of transport energy use provided by improved community design, can be expected to have positive impacts on air quality by reducing emissions of local pollutants. These in turn may have significant positive impacts on human health.

Improvements in community design that encourage pedestrian and bicycle transit can provide the added benefit of increasing the physical activity of and interaction among members of the community.

Improvements in compact, transit oriented, community design may contribute significantly to the preservation of forestlands, with possible impacts on reducing loss of carbon from forest biomass stocks that might otherwise have been removed.

Improvements in compact, transit oriented, community design may contribute to the preservation of farmland and farm jobs, while minimizing importation of food from foreign countries with resultant greenhouse gas impacts.

Improvements in compact, transit oriented community design may contribute to the preservation of open space and recreational lands, important in the quality of life and promoting public health through recreation choices and livable communities.

Feasibility Issues

The gap between the current market dynamics and societal green house gas emission reduction targets can only be bridged using strategies combining incentives and more stringent regulations, including more stringent building energy codes.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-4 Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations

Mitigation Option Description

Existing buildings will continue to consume the bulk of the energy used in the residential and commercial sectors in Washington for many years. This option would promote and provide incentives for the improvement of the resource (including energy, water, and other resources) efficiency of the existing building stock. Key to reducing energy use and GHG emissions in existing buildings are building operations, maintenance, and occupant behavior (for example, via total resource management systems).

Mitigation Option Design

This option is designed to facilitate substantial improvements in the efficiency of existing buildings in Washington through a combination of measures related to building design, code enforcement, energy performance review, and improvements in building operations. Elements of this option are expected to work in concert with lending/financing elements of RCI-2, and with energy efficiency incentive and building/community design elements of RCI-1 and RCI-3.

Elements of this option could include:

- Promoting commercial benchmarking, retro-commissioning and Building Operator Certification (BOC) consistent with 2030 Challenge baseline work, in all facilities of large-portfolio organizations.
- Supporting code enforcement, retro-commissioning, and building operator certification, as applicable, when buildings are sold.
- Support for energy efficiency lending.
- Encourage the use of free markets to drive innovation and change, rather than imposing prescriptive regulations. Government policies should help spur development of new technologies and foster the creation of new markets.
- Commercial benchmarking and retro-commissioning consistent with 2030 Challenge baseline work (and/or with other green building certification systems).
- Focusing on building operations, maintenance, and occupant behavior.
- Encourage the retrofitting of existing buildings to significantly improve the energy efficiency of the existing residential, commercial, and industrial building stocks (see goals below).
- Requirements for upgrading the energy efficiency of buildings at the time of resale, and/or evaluation (as needed) and labeling of building energy efficiency when buildings are purchased or leased so that the financial impacts on new owner/renter related to energy consumption can be

clearly recognized[26]. For example, California just adopted AB 1103, requiring that all nonresidential buildings disclose Energy Star Portfolio Manager benchmarking data and ratings for the most recent 12 month period, to a prospective buyer, lessee or lender.

- An incentive program that results in more resource conservation managers being hired by public and private organizations that own and manage medium and large facilities.

Note that some of these elements will be more applicable to commercial and industrial buildings than to residential buildings, and vice versa, and in many cases flexible application of requirements and incentives will be needed in projects, such as mixed-use residential and commercial projects, that do not fall readily into specific consumer categories.

Goals:

- Propose energy performance metrics that help define and communicate energy use and environmental impact
- Identify systems that can accelerate savings and lower cost of implementation
- Reduce energy use in 50% of the existing residential, commercial and industrial building stock by an average of 20% by 2020 in the near term, with a long-term target of carbon neutrality.

Timing: As noted above.

Coverage of parties: None cited.

Other: None cited.

Implementation Mechanisms

More specific possible implementation mechanisms for some of the elements of this option include:

Promote retro-commissioning and BOC in all facilities of large portfolio organizations:

- Through state legislation, require benchmarking and commissioning whenever buildings are sold, financed or refinanced.
- Task CTED and or DOE to work with utilities and help coordinate and promote utility energy conservation incentive programs aimed at existing facilities; consider legislation adding gas utilities to the requirements of I-937 (i.e., if they have more than 25,000 retail customers, they would be required to achieve all cost effective energy conservation within similar timeframes as required by I-937).
- Voluntary lighting upgrades supported by state technical assistance.
- Require, and fund, bi-annual re-commissioning of all state-funded buildings to ensure maximum operational efficiency.
- Provide state tax incentives for building owners- public and private - to invest in cost effective energy conservation and measures.
- Promote availability of existing state and utility incentives for distributed generation.

[26] Requirements for upgrading may cause difficulties for low-income residents wishing to sell their homes; such must therefore be carefully designed. See “Feasibility Issues” below.

Focus on building operations, maintenance, and occupant behavior:

- Provide consumers with real-time information on their energy consumption: provide incentives for in-home displays (concept of an energy "dashboard" or "speedometer") of energy use, energy costs, carbon consumption, water use, etc., and include context, e.g., how are you doing compared to your neighbors. Couple with information on products/services available for investment
- Job development and career training: one constraint to deep energy savings is the lack of trained professionals and trades people that can provide solutions and implement strategies. There is a need for additional educational and training opportunities aimed at the construction industry. Certification of building professional in "green building", as noted in RCI-3 and RCI-8, is also desirable.
- Develop outreach and education programs aimed at traditionally underserved populations who are energy users, i.e., public housing authorities, charities, non profit organizations, etc.
- Conduct a state-wide campaign aimed at encouraging behavioral changes. Models in California (e.g. Flex Your Power) have had significant success at reducing statewide residential energy demand.

Requirements for upgrading the energy efficiency of buildings at the time of resale

- Establish minimum energy performance standards, energy rating systems, and/or cap energy budgets at the time of sale.
- Establish (or facilitate by opening up legal pathway) point of sale and point of rental requirements for energy efficiency audits and upgrades, including labeling of the energy efficiency of buildings being rented or sold. Models for this type of program have been developed by Berkeley, San Francisco, Oakland (CA), and by Austin (TX) and Burlington (VT) could be applicable.
- Provide assistance to non-profit organizations, charities and affordable housing to allow those properties to access energy conservation incentive programs (e.g., utility programs) and to meet the same energy performance standards.
- Secure commitment of state and local government entities to undertake energy efficiency upgrades and operational changes in government-owned and -operated facilities as a first step in moving the market.

Related Policies/Programs in Place

- LEED requirements apply to some remodeled building, see RCI-3.
- LEED-EB is applicable to the existing commercial building stock and provides a good guideline for achieving operational savings.
- The Built Green program and others certification standards may also be applicable to energy efficiency upgrades of existing buildings as supported by this option.
- Many of the state's utilities (notably, Puget Sound Energy, Seattle City Light, Avista and SnoPUD) offer financial incentives to pay part of the cost of retrofitting commercial, institutional and residential buildings to make them more energy efficient.

- Initiative 937, passed by Washington voters in 2006, requires electric utilities (who have more than 25,000 retail customers) to acquire all cost effective energy conservation. Much of that conservation will come from retrofits in existing homes and facilities.
- Executive Order 05-01, Establishing Sustainability and Efficiency Goals for State Operations directs state agencies to achieve specific sustainability goals and required actions and incorporate green building practices based on LEED standards into new building construction and major remodeling projects.
- Many local governments such as Seattle and King County require their new and remodeled facilities to be at least Silver LEED.
- Generally, renovated commercial and residential buildings must meet applicable sections of the energy code if the renovation work involves a relevant section of the code (e.g., if there is a building addition, walls and windows must meet code.)

  The state's Housing Trust program, which provides financing to housing authorities, housing non-profits, etc, will be implementing its Evergreen Sustainable Building Standard in 2008. Among other green building elements, the standard will result in housing that is ~15% more energy efficient than code now requires and, if appliances are being installed in the housing, they are required to be Energy Star.

  Several local governments in the U.S. have established residential energy conservation ordinances that institute minimum energy efficiency time of sale requirements for residential properties, with the goals of reducing energy consumption and energy costs for residents. Properties must be inspected at the time of sale, and must demonstrate compliance with the local energy efficiency requirements. Several programs set a specific spending cap for energy efficiency improvements at levels ranging from 0.75 – 3% of the property's sale price. Programs in Berkeley, San Francisco, and Davis, CA apply to all residential properties, while programs in Burlington, VT and the state of Wisconsin apply only to rental properties.[27] The city of Berkeley has reported an overall reduction in residential energy consumption of 13% through the ordinance, and a reduction in household energy bills of up to $450 annually.[28]

Type(s) of GHG Reductions

As with RCI-3, GHG benefits will result predominantly from reduced CO_2 emissions from lower levels of natural gas, fuel oil, and LPG combustion at end-user sites, and from reduced central-station fossil-fueled electricity generation caused by reduced end-user demand for electricity. Additional upstream CH_4 and CO_2 savings could occur due to incremental reduction in natural gas transmission, distribution, processing, and extraction activities.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

[27] A tabular summary of several Residential Energy Conservation (and similar) ordinances is available as http://ci.boulder.co.us/files/appendix_a_reco_programs.pdf.

[28] Savings in the Berkeley program are as reported by the C40 Large Cities Climate Summit in "Berkeley's Building Standards Mandate Increases Efficiency and Pays Back Householders in Two Years" (http://www.nycclimatesummit.com/casestudies/building/bldg_berkeley.html) A summary of the specifications of the Berkeley program is available at http://www.ci.berkeley.ca.us/sustainable/residents/resSidebar/reco.html.

Preliminary Results

		Reductions ($MMtCO_2e$)*			NPV (2008–2020) $ millions	Cost-Effective-ness $/tCO_2$
	Policy	**2012**	**2020**	**Cumulative Reductions (2008–2020)**		
RCI-4	Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations	1.0	4.2	24.2	-$529	-$22

Please see the Appendix to this document for additional details of inputs to, data sources used for, and results of the analysis of this option.

Data Sources:

- Initial figures for the costs of building energy efficiency improvements were derived from The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association, The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report can be found at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.

Possible additional references for estimating GHG emissions reductions and associated costs include:

- ACI Summit: Moving Existing Homes Toward Carbon Neutrality:
  - Industry Stakeholder Recommendations for DOE's RD&D for Increasing Energy Efficiency in Existing Homes (http://www.affordablecomfort.org/images/Uploads/f_ind_stake_recommendations.pdf)
  - Whole-House Energy Analysis Procedures for Existing Homes (**http://www.affordablecomfort.org/images/Events/30/E_WholeHouseEnergyAnalysis.pdf**)
  - **Existing Homes Target Market Assessment (http://www.affordablecomfort.org/images/Events/30/B_marketreport_doemod.pdf)**
  - US Residential energy expenditure **(http://www.affordablecomfort.org/images/Events/30/C_US_Residential_energy_expenditure.pdf)**
- UNEP, "Buildings and Climate Change: Status, Challenges and Opportunities." (**http://www.uneptie.org/pc/sbc/documents/Buildings_and_climate_change.pdf**)
- Summary and Recommendations of the *Getting to Fifty* Summit (**http://www.newbuildings.org/gtf/documents/GT50_Summit_Final_Report.pdf**)
- Options for Energy Efficiency in Existing Buildings (**http://www.energy.ca.gov/2005publications/CEC-400-2005-039/CEC-400-2005-039-CMF.PDF**)

- The CEC (California Energy Commission) and CalEPA may have useful data/analyses on the benefits of code enforcement, retro-commissioning, and building operator certification, and of changes in occupant behavior, respectively.

Quantification Methods:

Quantification Approach: Starts with estimates of energy use (electricity, natural gas, and other fuels) in private-sector buildings in Washington, by sector, and ramps in assumption of 20 percent reduction in (electricity and fossil-fuel) energy use in 50 percent of existing buildings by 2020. Uses existing studies of the cost of building energy efficiency improvements to estimate the cost of making these improvements (through retrofits or improvements in operations) to estimate the incremental cost of the option. *(Note that energy savings and emission reductions will likely overlap considerably with other RCI options; an integrated analysis of combined impacts will be undertaken at a later stage.)*

Key Assumptions:

- Total average reductions in electricity and gas use through a combination of efficiency measures, renewable energy use (solar thermal, solar PV, and biomass), and green power purchases (beyond the levels included in a state renewable portfolio standard) are 20 percent of average 2005 use of electricity and gas per residential unit and per unit commercial floorspace.
- Program reaches 50% of all homes and commercial and industrial buildings existing as of 2005 by 2020.
- Costs of solar water heat and solar PV decline over time (but remain higher than avoided conventional energy costs).
- Most (85 to 96%, depending on year and fuel) reductions in conventional energy use are from application of energy efficiency measures. Solar water heating accounts for 3 percent of conventional energy use reductions in 2012, rising to 5 percent in 2020, and solar PV power accounts for 1 percent of electricity use reduction in 2012, rising to 2 percent in 2020. Biomass use accounts for 1 percent of conventional energy use reductions in 2012, rising to 3 percent in 2020.
- Efficiency measures applied to existing residences and commercial buildings are assumed to have an average levelized cost of $31 per MWh electricity saved, and $5.4 per MMBtu natural gas saved.

Contribution to Other Goals

- **Contribution to Long-term GHG Emission Goals (2035/2050):** see BPA's 5th Power Plan for electric energy conservation potential in existing buildings.
- **Job Creation:** There are numerous studies that document the multiplier effects of dollars spent on conservation. (See also notes on Job Creation under RCI-1.)

- **Reduced Fuel Import Expenditures:** All energy produced by natural gas, coal[29] and propane that is used by Washington buildings and facilities is imported, so all fossil fuel energy savings results in fewer Washington dollars being exported.

Key Uncertainties

None cited.

Additional Benefits and Costs

Increased energy efficiency keeps dollars in Washington, often also produces increased water use efficiency, produces financial savings for utility bill payers, increases business profits, and increases buying power of consumers.

Feasibility Issues

If this option includes required upgrading of residences to improve their energy efficiencies to meet code requirements at the time of sale, residents who depend on the value of their home to fund their retirement, but who may not be able to afford the necessary upgrades to ready their house for sale.

Some jurisdictions have chosen to address this issue through targeted incentives or by initiating a "refundable deposit system," such that cost of upgrades is built into the sale price and burden of completion falls upon the buyer, rather than the seller.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

[29] It is unclear whether Trans-Alta's coal plant is selling power Washington utilities, thus it is not certain that coal-fired power is used in Washington.

RCI-5 Rate Structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues)

Mitigation Option Description

Traditional regulatory frameworks tie a utility's recovery of fixed costs of providing service (for example, infrastructure costs) to the quantity of energy sold. There is thus a perverse incentive for utilities to increase sales in order to increase revenues and minimize investments in energy efficiency (which will simply lead to lower than anticipated sales). This option includes the implementation of cost recovery rules that "decouple" the level of utility sales from net revenues earned by investor-owned utilities.

This option also includes elements of utility rate design that are geared toward reducing greenhouse gas emissions, often with other benefits as well, such as reducing peak power demand. The overall goal of this option is to revise rate structures—and provide metering technologies to implement revised rate structures—so as to better reflect the actual economic and environmental costs of producing and delivering electricity as those costs vary over time.. These new rate designs provide consumers with information reflecting the impacts of their consumption choices. Most Washington electric utilities do incorporate some form of rates that provide incentives to conserve energy and/or reduce loads in their rate structures[30], but there are opportunities to further use rate design and metering infrastructure to support the reduction of greenhouse gas emissions.

Mitigation Option Design

Elements of this option could include:

- Implement rate structures and utility cost recovery rules that "decouple" the level of gas and electric utility sales from the net revenues earned by investor-owned utilities. Decoupling mechanisms have been implemented or are under consideration in a number of western states[31], and several Washington utilities have received or applied for permission from the Utilities and Transportation Commission to implement decoupling at least to some degree (see Related Policies/Programs in Place, below). (Note that decoupling is not, generally, applicable to the operations of municipal and cooperative utilities.) Decoupling, if introduced, should be geared exclusively to removing barriers to utility investment in programs to increase their customers' energy efficiency and reduce customer loads. Decoupling mechanisms should be carefully

---

[30] Including, for example, Puget Sound Energy (see http://www.pse.com/InsidePSE/ratesDocs/summ_elec_prices_2007_10_01.pdf), and Seattle City Light (see http://www.seattle.gov/light/accounts/rates/docs/2007rsc.pdf).

[31] A review of states' experience in decoupling is provided in the report Aligning Utility Interests with Energy Efficiency Objectives: A Review of Recent Efforts at Decoupling and Performance Initiatives, by Marty Kushler, Dan York and Patti Witte of the American Council for an Energy-Efficient Economy, available as http://www.aceee.org/pubs/u061.htm.

designed so as to avoid, as much as possible, adverse economic impacts on ratepayers so that factors other than energy efficiency investments—such as economic downturns—do not adversely affect rates, and to assure that any decoupling mechanism is fair to both consumers and shareholders.

- Implementing, where not already used and as appropriate, tiered (increasing block) rates for electricity and natural gas use, which provide affordable base usage rates for residential consumers, but which increase with increasing consumption.
- Implementing different types of rate structures and bases for rate structures, including designing rates to encourage construction of homes that are sized so as to reduce energy use[32]. Any new rate structures, however, should be designed so as not to have a negative affect on low-income electricity and gas consumers, and/or should be combined with the development of programs to allow low-income consumers to take advantage of opportunities to reduce their bills.
- Encourage demand response programs that provide incentives to customers to voluntarily reduce their load at times of system peaks, and implement time-of-use (TOU) rates provide an incentive for customers to shift their usage from peak to non-peak periods and thereby, reducing the need for utilities to have to utilize their least efficient, least environmental-friendly generation resources.
- Implement “Smart Metering”--consumer electric meters showing real-time pricing and the level of GHG emissions related to consumption at any given time. Smart meters are described as providing consumers with the information needed to make consumption choices, and can include the capability for consumers to adjust the type of power (for example, “green” versus conventional power) “on the fly”.[33]

Regulations and regulatory frameworks exist in Washington to develop and implement rate structures that provide incentives for energy efficiency improvement, and such rate structures are under discussion or being implemented in several utility areas (see “Related Policies and Programs in Place). Utilities, regulators, and other should work with and within these regulations and frameworks to develop additional rate structures that contribute to GHG emissions reductions.

Goals:

- Remove regulatory and financial barriers to natural gas utility investments in cost-effective conservation, so as to better align the interests of utilities and customers, and to support GHG emissions reduction goals set out in the Governor’s Executive Order.
- Implement customer rebate and education programs, and changes in rate design, in support of other RCI options.

Timing: Time implementation of regulatory changes so as to support Executive Order goals. Implement pilot smart metering program in 2009 and 2010 (see below).

---

[32] Carbon tax legislation being drafted by a member of the U.S. Congress includes provisions that would phase out mortgage tax exemptions on larger homes unless they meet “carbon neutral” criteria. See http://www.house.gov/dingell/carbonTaxSummary.shtml.

[33] A study on “smart metering” was, as of late August, 2007, being contracted for by CTED, with results expected in late 2007. A brief description of Smart Metering, and its planned implementation by a utility in the Detroit (MI) area, is available at http://www.detnews.com/apps/pbcs.dll/article?AID=/20070813/BIZ/708130348.

Coverage of parties: Washington Utilities and Transportation Commission, electric and gas utilities, and residential sector consumers.

Other: None cited.

Implementation Mechanisms

In addition to those noted in the "Policy Design" section above, potential implementation mechanisms for this option include:

- Modifying policies to align utility incentives with the delivery of cost-effective energy efficiency, and modify ratemaking practices to promote energy efficiency investments. Programs could be based on efforts in this are through the National Action Plan for Energy Efficiency[34], the ACEEE Report: *Aligning Utility Interests with Energy Efficiency Objectives* described above, and related program models in California and Oregon.
- Develop and implement a pilot program of installation of smart meters at residential customers' sites by 2009, with installations starting in 2010. The pilot program could target installation of smart meters in roughly one (1) percent of homes in Washington. The pilot program may also include installations of smart meters for commercial and industrial consumers.
- If the pilot "smart metering" program is successful, consider implementing meters statewide.
- Recommend the legislature propose a customer rebate program in future legislation.
- Implement a customer rebate program that gives customers a percentage rebate on bills if they are able to reduce their consumption by a certain percentage during certain periods of the year. (for example, by reducing use of natural gas in the winter to heat the home)
- Continue to improve on existing energy-efficient programs already implemented by the state.
- Consider implementing a policy that all new electricity meter installations (meters for new buildings) must be "smart meters", and for existing electric meters to be retrofitted to smart meters[35].
- Education programs should be deployed that demonstrate the nexus between consumers' behavior and the impact on energy use and consequently, increases in GHG emissions (see RCI-8 for additional proposals regarding education).

Related Policies/Programs in Place

American Gas Association's (AGA) April 2007 "Rate Round Up" includes a summary of "innovative" rate programs across the country. Two natural gas utilities in Washington State are currently implementing [pilot] decoupling programs: Avista and Cascade Natural Gas. An excerpt from the AGA document follows:

[34] http://www.epa.gov/cleanrgy/actionplan/eeactionplan.htm

[35] As an example, it has been estimated that it would take a specific Washington utility 3 to 5 years to convert its 45,000 meters to an automated meter reading system with 2-way communications and a number of "smart metering" features. Ratepayers would pay about $4 per month for 3-4 years to pay for the system, which would provide advantages including on-demand and remote meter reads, remote on/off control of the meter, improved outage management and system monitoring (optimized dispatch of power), web-based customer usage readouts, and tracking of power usage on a daily basis (to allow monitoring of problems and power spikes quickly).

"Washington - Avista

On February 1, 2007, Avista received approval from the Washington Utilities and Transportation Commission to implement a partial decoupling mechanism on a three-year pilot basis. The program, which does not include losses related to weather, will apply to residential and small commercial customers, and rate increases from the program will be capped at 2 percent per year. The company had recently completed a rate case when it filed its petition.

Avista is to defer 90 percent of the non-weather-related margin difference (positive or negative), which is to be recovered from or returned to customers. The recovery of any deferred costs is subject to both an earnings test that would prohibit collection if Avista is earning above its authorized 9.11 percent rate of return, and a demand-side management (DSM) test that would prohibit collection if specific conservation targets are not achieved. Funds not recovered due to the earnings and/or DSM tests may not to be carried over to the next period. Also, the commission prohibits Avista from earning interest on deferrals until the deferrals are approved for recovery.

Avista must submit an evaluation of the mechanism and any proposed modifications if it wishes to continue the program after three years. The commission stated that the mechanism will be evaluated, and extension granted, only if there is a demonstration that the mechanism led to cost-effective enhanced conservation."

Washington - Cascade Natural Gas

On January 12, 2007, the Washington Utilities and Transportation Commission authorized Cascade Natural Gas to implement a partial decoupling mechanism on a pilot basis for a three-year period. The mechanism, which will apply to residential and general service commercial customers, would defer non-weather-related margin variances (e.g., changes in usage related to conservation and energy efficiency improvements). In connection with the decoupling mechanism, the settlement called for Cascade to submit a conservation plan, which would be filed after the settlement was approved and an advisory group was convened to review an outside consultant's assessment of the energy efficiency potential in the company's service territory. The settlement specified that the plan would contain targets and benchmarks based on recommendations from the advisory group, and opportunities for penalties and/or incentives. Cascade's program includes paying for customer incentives on rebates for cost-effective demand side management programs, such as high efficiency appliances, insulation and consumer education programs. The decoupling program will be subject to commission approval of a conservation plan, with earnings capped at the authorized 8.85 percent overall rate of return, and will include penalties for failure to meet conservation targets and benchmarks. The pilot program will be evaluated regardless of whether the company seeks to continue the program after the three-year period expires.

This case was a follow up to the company's previous proposal before the Washington commission. In May 2005, the commission issued a proposal to decouple utilities' gas volume sales from their recovery of fixed costs. As part of the proceeding, the commission considered a decoupling petition by Cascade Natural Gas that was outside of a rate case. The commission ultimately denied the petition and said that the issues were better considered within a rate case.

http://www.epa.state.il.us/air/climatechange/documents/subgroups/power-energy/aga-update-on-revenue-decoupling-mechanisms.pdf

State EE/RE Technical Forum: Decoupling and Other Mechanisms to Address Utility Disincentives for Implementing Energy Efficiency, http://www.epa.gov/cleanenergy/pdf/keystone/Background_Decoupling_5-19-05_PQA_final.pdf

The establishment of a policy to remove the disincentive for utility investments in energy efficiency was a key element of California's energy efficiency success.[36]

Type(s) of GHG Reductions

GHG benefits will result predominantly from reduced CO_2 emissions from lower levels of natural gas combustion at end-user sites, and from reduced central-station fossil-fueled electricity generation caused by reduced end-user demand for electricity. Additional upstream CH_4 and CO_2 savings could occur due to incremental reduction in natural gas transmission, distribution, processing, and extraction activities.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

Preliminary Results (for Smart Metering and Inverted Block Rate Elements)

		Reductions ($MMtCO_2e$)			NPV (2008–2020) $ millions	Cost-Effective-ness $/tCO_2$
	Policy	2012	2020	Cumulative Reductions (2008–2020)		
RCI-5	Rate Structures and Technologies to Promote Reduced GHG Emissions (including Decoupling of Utility Sales and Revenues)	0.1	0.3	2.9	-$226	-$78

Data Sources:

Potential data sources for additional analysis include:

US EPA. Business Case for Energy Efficiency:

http://www.epa.gov/cleanenergy/pdf/napee/napee_chap4.pdf

US EPA. Business Case Details:
http://www.epa.gov/cleanenergy/pdf/napee/napee_appb.pdf

National Association of Regulatory Utility Commissioners (NARUC): In 2006 and prior years, NARUC adopted several resolutions encouraging state and federal regulatory commissions to implement innovative rate designs, including energy-efficiency tariffs and decoupling tariffs, to promote energy efficiency and conservation.

---

[36] Energy Efficiency in California and the United States. White Paper. Audrey B. Chang, Arthur H. Rosenfeld, and Patrick K. McAuliffe. 2007. Related presentations available at: http://www.energy.ca.gov/commission/commissioners/rosenfeld_docs/index.html

Quantification Methods:

Most of the rate-structure-related elements of this option can be considered to be in support of other RCI (and in some cases ES) options, and furthermore the ability to quantify their impacts is somewhat limited. One element that can be roughly quantified is tiered (increasing block) rate structure, for which some studies exist. Based on TWG assumptions about the relative pricing of different blocks, parameters of existing studies can be adapted. The other element that can be roughly quantified is the "smart metering" element of this option, which can be estimated more directly, by assuming a ramp-in of a fixed number of (or a fraction of customers coved by) smart meters, and using existing studies to estimates a fractional energy use reduction by customers using the meters.

Key Assumptions (see Appendix for references and data sources)

- Smart meters program
- Pilot program phased in over 3 years
- Smart meters cost an average of $200 each
- Smart meters induce savings of 8 percent of projected consumption
- Inverted block tariffs:
- Apply to an additional 35 percent of residential consumers. At present Avista, PacifiCorp, Puget Sound Energy, and Seattle City Light have strongly tiered residential rates, but other Washington utilities (investor-owned and public) appear not to.**37**   The utilities currently without strongly tiered residential rates account for over 40 percent of Washington's residential customers.
- Inverted block tariffs induce savings of 4 percent of projected consumption, with this savings assumed to be due to curtailment of household electricity use (conservation), that is, by reducing consumption, but not through implementing energy efficiency measures.
- There is no significant incremental cost in implementing tariff changes

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050): None cited.

Job Creation: (See notes on Job Creation under RCI-1.)

Reduced Fuel Import Expenditures: None cited.

Key Uncertainties

Impact on low income people: Whatever policy options that are implemented need to be mindful of the impact on low income individuals. A raise in utility costs could be extremely disproportionate to this class of people. Moreover, low income families tend to use the most inefficient heating and cooling systems.

[37] As of approximately 2003, Steilacoom did have tiered rates, but as the rates increased by only a few percent per tier, these are not considered "strongly tiered".

Increasing Tier Block (Inverted block): could result in large bill increases for users that cannot change their usage level and could encourage more use by the smaller users. Additionally, commercial & residential facilities are not homogeneous and therefore, this approach does not work for commercial and industrial consumers.

Smart Metering: recommend a study of this rate design option to ensure that the benefits justify the cost. For example, could monitor or study the program being considered by the Energy Trust of Oregon. A somewhat different, but related, program of Time of Use (TOU) rates was carried out on a large scale (300,000 households) by Puget Sound Energy (PSE) in approximately 2001 and 2002. The results of this program showed that the program was not cost-effective from most perspectives and that while there was a significant reduction of on-peak energy use (load shifting), greenhouse gas emissions reductions for Washington did not necessarily result, as load shifting may have displaced, at the margin, gas-fired peaking energy with baseload coal-fired energy.[38]

Additional Benefits and Costs

Benefits

- Reducing dependence on imported fuel sources;
- Reducing vulnerability to energy price spikes;
- Reducing peak demand and improving the utilization of the electricity system;
- Reducing the risk of power shortages;
- Supporting local businesses and stimulating economic development;
- Enabling avoidance of the most controversial energy supply projects;
- Reducing water consumption by power plants; and
- Reducing pollutant emissions by power plants and improving public health.

Costs

- A welfare cost is implied (reduction in household utility) when customers curtail electricity use in response to higher rates.
- To the extent that fuel-switching (for example, to gas or wood) occurs in response to the rate structures employed in this option, there will be additional costs for fuel and possibly equipment, and some additional emissions, that should be considered.

Feasibility Issues

Past experience (including the PSE TOU program referred to above) indicates that rate structure changes must be implemented and monitored carefully to assure that the customer response fulfills the goals of the programs, and to assure that unexpected negative consequences do not occur.

[38] See, for example, Jim Lazar, Pacific Coast Demand Response and DG Program, prepared in 2006 for the Regulatory Assistance Project (available as http://www.energetics.com/madri/pdfs/LazarMADRISep2006.pdf). See also July 1, 2003 Time-of-Use Milestone Report, submitted to the Washington Utilities and Transportation Commission on July 1, 2003 under "Docket Nos. UE-011570 & UG-100571 Time-of-Use Compliance Filing".

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-6 Provide Incentives to Promote and Reduction of Barriers to Implementation of Renewable Energy Systems

This option was pursued jointly with the ES TWG, and is described in the ES TWG documentation under ES-2.

RCI-7 Provide Incentives and Resources to Promote and Reduction of Barriers to Implementation of Combined Heat and Power (CHP, or "cogeneration") and Waste Heat Capture, Including Net-metering for Combined Heat and Power

This option was pursued jointly with the ES TWG, and is described in the ES TWG documentation under ES-7.

RCI-8 Consumer Education Programs, Including Labeling of Embodied Life-cycle Energy and Carbon Content of Products and Buildings

Mitigation Option Description

The ultimate effectiveness of emissions reduction activities in many cases depends on providing information and education to consumers regarding the energy and GHG emissions implications of consumer choices. Public education and outreach is vital to fostering a broad awareness of climate change issues and effects (including co-benefits, such as clean air and public health) among the state's citizens. Such awareness is necessary to engage citizens in actions to reduce GHG emissions in their personal and professional lives. Public education and outreach efforts should integrate with and build upon existing outreach efforts involving climate change and related issues in the state. Public education and outreach will be the foundation for the long-term success of all of the mitigation actions proposed by the Washington CAT, as well as those that may evolve in the future. Education and certification programs for professionals involved in delivering services in support of RCI and other policy options considered by the CAT must also be developed and implemented.

This option would additionally include elements to estimate the embodied life cycle energy use and carbon emissions associated with products and buildings, to label products and buildings being sold so as to provide feedback to consumers on their "carbon footprint", and to encourage the use of lower-carbon products and building materials.

Mitigation Option Design

Elements of this option could include:

- Coordinating climate and energy efficiency education programs throughout the state, including education and energy-efficiency programs offered by utilities.
- Implementing requirements for retail education (on packaging or on a handout provided at the time of purchase), that will inform consumers about the energy consumption of the products and materials (including building materials) they buy, and how to operate or use products in the most energy-efficient manner. These requirements should take advantage of and build upon existing Energy Star initiatives and certification programs, and be implemented in coordination with retail sales organizations where applicable.
- Engaging industrial firms to promote LEAN manufacturing techniques and other practices to reduce unnecessary energy and material consumption, and engaging small businesses on GHG emissions reduction by using environmental impacts education materials.
- Enhancing the coverage of energy and environmental issues, including climate change, in public school curricula at all levels to shape long-term behavior.
- Work with community colleges, universities, labor organizations, governments, business organizations, and businesses to promote the development of programs for training of a much

expanded “clean energy workforce” to work in fields like energy efficiency, distributed and renewable energy, and the “green building” (see below) trades.

- As noted in RCI-3, there is a need to provide suitably trained building professionals with “green building” certification so that potential purchasers and developers of green buildings can be assured that builders and designers so designated are equipped to produce green buildings, and building code enforcement officials have suitable training to apply advanced building energy codes. A preliminary step here would be to adapt, adopt, and/or develop a suitable set of qualifications that building professionals must meet to receive a green building certification. Certification programs should be offered for both individual builders and designers and for contracting and design companies, though specific rules will need to be developed for certified companies to assure that the individuals within a company who work on a given green building project are properly trained to do so. Ultimately, building energy efficiency qualifications should be built into requirements for receiving licenses in building-related professions, and certification programs should build toward this goal.
- Consider and evaluate “carbon labeling” of products, and how this might be done in a consistent and verifiable manner[39], possibly on a regional (e.g. Western Climate Initiative) or federal level. A labeling scheme would indicate to the consumer the total embodied carbon emitted during the life cycle of a particular product (including the product and the packaging). The design of effective labels and of systems of labeling implementation should avoid being unduly burdensome, and should benefit from previous labeling programs in Washington and elsewhere, wherever possible. Life cycle analysis should consider the direct emissions including the phases of production: raw material, product manufacturing, distribution and retail, consumer use (is it refrigerated, etc), and recycling. The life-cycle analysis would determine the total amount of carbon emitted during the creation and use of the product and that number would be put on the carbon label. This label would also indicate that the company has made a commitment to reducing the carbon footprint of the specific product over the course of two years. This type of labeling would inform consumers about the embodied carbon footprint of a particular product, giving them the opportunity to influence corporate practices through their buying power. Companies participating in the program would also be able to show that they are committed to reducing their carbon footprint and to mitigating climate change. Carbon footprint labeling could coordinate with programs related to disclosure of building energy use when a building is offered for lease or sale (as suggested in RCI-4)[40]. Pilot programs to gauge the impacts of labeling on consumer behavior may be a useful first step in developing labeling systems, with effective programs subsequently implemented broadly.

Goals: Consumer, K-12, and technical/professional education course should be developed so as to provide timely support to other options recommended by the CAT, and to support the GHG emissions reduction goals set out in the Governor’s Executive Order. The carbon labeling initiative described above would cover all products sold within Washington State.

Timing: For the carbon labeling program, full implementation by 2020 with phased implementation starting with highest priority items identified by an advisory panel.

[39] The CAT notes that some products are produced from a mix of raw materials that may vary over time, and this particular challenge should be taken into account.
[40] See “Related Programs/Policies in Place”, below, for references to carbon labeling programs being investigated elsewhere.

Coverage of parties: Consumers, Retailers, Manufacturers, Government Agencies, K-12 Public Schools, Community Colleges, Universities, Technicians and Professionals in Building and related trades.

Other: None cited.

Implementation Mechanisms

In addition to the actions noted above, potential implementation mechanisms for this option include:

- A consumer education requirement at the time of sale for key products.
- Labeling of building materials in reference to CORRIM study[41] and LCA[42] work.
- Providing tools and information for residents, businesses and communities to perform GHG inventories, and to evaluate and act upon inventory results.
- Expanding climate involvement and participation within communities.
- Developing programs to have state agencies/local governments promote improvements within small business sectors and trade associations by using existing models for business education of environmental impacts.
- Convene an advisory panel to help in developing carbon labeling standards and protocols.

Related Policies/Programs in Place

Carbon Labeling

The UK is implementing a program of carbon labeling through the UK Climate Trust. The methodology for determining the carbon footprint of each product can be found here: http://www.carbontrust.co.uk/NR/rdonlyres/6DEA1490-254B-434F-B2B2-21D93F0B0C98/0/Methodology_summary.pdf. The development of carbon labeling programs for various products is also underway in Oregon and Connecticut, including labeling programs for automobiles.

Type(s) of GHG Reductions

This option supports the reductions in GHG emissions at the end-user and power plant level noted for RCI-1, RCI-3 through RCI-5, and other RCI options.

Estimated GHG Savings (in 2020) and Costs per $MtCO_2e$

Data Sources:

Analysis on carbon labeling programs being developed/implemented in Oregon and Connecticut.

41 http://www.corrim.org/reports/2006/fpj_oct_2006/FPJproductSubs.pdf
42 http://www.epa.gov/ORD/NRMRL/lcaccess/

Quantification Methods:

The elements of this option support other RCI options and options being developed by other TWGs. As it is difficult, however, to ascribe specific and direct GHG savings to the elements included in this option, the savings and costs of this option will not be separately quantified.

Key Assumptions: None cited.

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050):

- Significant potential for long term GHG reduction savings

Job Creation: (See notes on Job Creation under RCI-1.)

Reduced Fuel Import Expenditures: None cited.

Key Uncertainties

None cited.

Additional Benefits and Costs

None cited.

Feasibility Issues

None cited.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-9 Identification of GHG Emissions Impacts and Measures to Avoid, Minimize, or Mitigate them for Projects Requiring Government Review, and in Designing Government Rules and Regulations

Mitigation Option Description

In 1997, then chairman of the Council for Environmental Quality, Kathleen McGinty drafted an interpretation of NEPA for federal agency heads finding that NEPA provides an "appropriate and feasible mechanism" for considering climate change drivers and consequences.[43] The option described below would require identification of the net impacts on GHG emissions of new government rules and regulations, and would require the identification measures to avoid, minimize or mitigate increases in emissions due to the implementation of those rules and regulations in order to prevent the unintended consequences (such as increasing GHG emissions). This option would additionally require SEPA (State Environmental Policy Act) review to quantify GHG emissions and identify measures to avoid, minimize or mitigate emissions for state-funded and/or privately funded projects, and would emphasize the incorporation of GHG emissions consideration in community planning and zoning decisions. Efficient community planning holds perhaps the greatest potential for future reductions of any mitigation strategy.

Mitigation Option Design

Elements of this option include:

- Requiring SEPA review to quantify GHG emissions and identify measures to avoid, minimize or mitigate emissions for projects requiring government review. SEPA already includes the authority to include GHG emissions as criteria in environmental reviews.
- GHG emissions impact review requirements for significant development projects modeled after the program in place in Massachusetts, in which private developers are required to estimate the greenhouse gases their large-scale projects will produce and reduce them with measures such as energy-efficient lighting, alternative fuels, or commuter shuttles. Large housing developments, office projects, and mixed-use developments that combine retail, industrial, and residential uses will be affected.[44]
- Covered projects could include:
    - All state-funded or proposed projects
    - Privately-funded projects that require a state air quality permit

---

[43] McGinty, K.A., 1997. Draft memorandum: Guidance regarding consideration of global climatic change in environmental documents prepared pursuant to the National Environmental Policy Act. *Council for Environmental Quality.*

[44] Massachusetts guidelines were scheduled for completion on July 1. See http://www.boston.com/news/local/articles/2007/04/22/mass_steps_up_climate_rules_for_developers/

- o Privately-funded projects that result in more than 3000 new vehicle trips/day.[45]
- A review of the energy intensity of the production of building materials used in projects, in order to provide incentives for use of low greenhouse gas building products.
- Requirements that all new projects reduce GHG emissions relative to standard practice, with on-site reduction of emissions preferred over off-site mitigation or offsets, other considerations being equal.
- A requirement that all government actions be reviewed for potential GHG impacts, with the review process designed to be efficient and low-cost.

Goals: Establish information disclosure requirements and data collection capacities enabling the state to quantify the impact of development on statewide GHG reduction targets to inform subsequent mitigation thresholds and target setting.

Timing: King County's two-phase model, which requires a year of information disclosure and data collection prior to developing specific mitigation thresholds and targets, may have great potential for replication statewide.[46]

Coverage of parties: Government agencies, municipal and county planners and zoning boards, private developers of substantial projects.

Other: None cited.

Implementation Mechanisms

Implementation mechanisms for elements of this option could include:

Climate Protection as a Required Element of Local Planning

- Provide funding/support for local governments to include greenhouse gas emissions considerations in local planning and zoning processes
- Provide guidance and training for local governments to enable them to effectively evaluate GHG emissions impacts of planning and zoning decisions.
- Add enforcement capabilities to State-level review of local plans, so as to assure that local plans are consistent with statewide climate strategies.

Related Policies/Programs in Place

SEPA

King County is currently undertaking these kinds of reviews of the GHG emissions implications of projects.

King County Executive Ron Sims announced in June of this year new county policy to officially add greenhouse gas emissions to the environmental review of construction projects within county borders. King County's policy covers projects undergoing environmental review mandated by the

[45] The threshold of 3000 new vehicle trips/day for private projects is the same as specified for "office projects" by the Commonwealth of Massachusetts Executive Office of Energy and Environmental Affairs in its Greenhouse Gas Emissions Policy, dated April 23, 2007.

[46] The results of the King County process should be monitored, evaluated, and built upon in designing processes adopted statewide so that SEPA GHG emissions impact review requirements for significant development projects are as efficiently implemented and straightforward to comply with as possible.

SEPA and applies to the County's own developments as well as projects where the County is the lead permitting agency. As a tool to help developers estimate their emissions, King County developed a “SEPA GHG emissions worksheet” that estimates most GHG emissions that will be created over the life span of a building project. This includes emissions associated with obtaining construction materials, fuel used during construction, energy consumed during the buildings operation, and transportation by building occupants. Currently SEPA applicants are only required to report their emissions as a means of information disclosure and gathering. King County is in the process of developing mitigation thresholds, compliance thresholds, as well as acceptable and quantifiable mitigation options. With the County Council through the 2008 Comprehensive Plan Update, county staff plan to include policy reaffirming the County’s substantive authority to require GHG mitigation for projects meeting a compliance threshold (as yet undefined) of climate impact, with the hope of implementation in early 2009.

The Puget Sound Clean Air Agency has the authority to conduct SEPA review of projects with GHG emissions impacts when it has been identified as a lead on a given project. SEPA regulations are interpreted by the Agency as giving the Agency the authority to regulate GHG emissions. City of Seattle neighborhood planning processes are also beginning to consider the impacts of those processes on climate.

California’s Attorney General brought a lawsuit against San Bernardino County, CA in April 2007, and just settled August 21:

“The agreement, approved … by the County Board of Supervisors, establishes a unique greenhouse gas reduction plan that will identify sources of emissions and set feasible reduction targets for the County.

Under [the] agreement, the County will embark upon a thirty month public process aimed at cutting greenhouse gas emissions attributable to land use decisions and County government operations. The Greenhouse Gas Emissions Reduction Plan mandates the following:

- An inventory of all known, or reasonably discoverable, sources of greenhouse gases in the County.
- An inventory of the greenhouse gas emissions level in 1990, currently, and that projected for the year 2020.
- A target for the reduction of emissions attributable to the county’s discretionary land use decisions and its own internal government operations.”[47, 48]
- Internationally, the Clinton Climate Initiative’s C40 Climate Leadership Group includes and emphasis on community planning for reduced GHG emissions.[49]

Type(s) of GHG Reductions

This option supports the reductions in GHG emissions at the end-user and power plant level noted for RCI-1, RCI-3 through RCI-5, and other RCI options..

[47] California Attorney General Press Release, “Brown Announces Landmark Global Warming Settlement,” August 21, 2007, http://ag.ca.gov/newsalerts/release.php?id=1453

[48] San Bernardino Settlement Agreement, August 21, 2007, http://ag.ca.gov/cms_pdfs/press/2007-08-21_San_Bernardino_settlement_agreement.pdf

[49] See, for example, http://www.c40cities.org/.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

Data Sources:

Potential data sources for additional analysis include:
Research in California, NYC and elsewhere has begun to quantify the impact of changes in community planning on GHG emissions. California estimates 10-15% of potential statewide reductions can be achieved through land use planning changes. New York City is estimating 15.6 million metric tons will be reduced through smart growth planning and design (accounting to approximately 30% of the City's total reduction strategy). Specific data sources associated with initiatives in other parts of the US are provided below.

PlaNYC: New York City PlaNYC 2030 estimates that attracting 900,000 new residents by 2030 will result in an avoided 15.6 million metric tons of CO_2e through avoided sprawl.[50] Methodology is not immediately apparent from the report but should be available through the New York City Office of Long Term Planning and Sustainability.

Center for Clean Air Policy (CCAP): CCAP is working with the State of California (through the Land Use subgroup of their CAT process) to quantify benefits of land use decisions.[51]

Massachusetts: Methodology under development by Massachusetts Department of Environmental Affairs (expected completion July 1, 2007 – uncertain of status).[52]

San Bernardino County: Very recent settlement with CA Attorney General's Office requires that County establishes targets for reducing sources of emissions "reasonably attributable to the County's discretionary land use decisions and the county's internal government operations…"[53]

CCAR: In the process of developing a local government protocol for measurement, would likely attempt to quantify some of the impacts associated with development patterns. White paper available late fall, Protocol target completion date: Summer 2008.

Quantification Methods:

Proposed Quantification Approach: As with RCI-8, the elements of this option support other RCI options and to options being developed by other TWGs. Given that the goals of this option are focused on information gathering and provision, it is difficult to ascribe direct emissions impacts to this option (though it would help to bring about the savings achieved in RCI-3, for example). Therefore it is proposed that the costs and impacts of this option not be quantified.

Key Assumptions: None cited.

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050):

A study released in October 2007 through a partnership between the Urban Land Institute, the National Center for Smart Growth Research, the Center for Clean Air Policy, and Smart Growth America, found that the potential impact of compact urban development was between a 20-40%

[50] http://www.nyc.gov/html/planyc2030/downloads/pdf/report_climate_change.pdf
[51] http://www.ccap.org/domestic/state.htm
[52] http://www.mass.gov/envir/
[53] San Bernardino Settlement Agreement, August 21, 2007, http://ag.ca.gov/cms_pdfs/press/2007-08-21_San_Bernardino_settlement_agreement.pdf

reduction in VMT, and, "making reasonable assumptions about growth rates, the market share of compact development, and the relationship between CO_2 reduction and VMT reduction, smart growth could, by itself, reduce total transportation-related CO_2 emissions from current trends by 7 to 10 percent as of 2050…and does not include additional reductions from complementary measures….The authors calculate that shifting 60 percent of new growth to compact patterns would save 85 million metric tons of CO_2 annually by 2030.[54]

Job Creation: (See also notes on Job Creation under RCI-1.)

- Significant potential to increase consultant and government jobs.

Reduced Fuel Import Expenditures: None cited.

Key Uncertainties

While SEPA review does require that projects identify alternatives and mitigation options, there is no requirement that these options are carried out. Hence, without concurrent zoning changes, incorporating climate impact into SEPA review could have little concrete impact on development patterns. As mentioned above, King County's two-phase model, which requires a year of information disclosure and data collection prior to developing specific mitigation thresholds and targets, has great potential for substantial GHG emission reductions.

Additional Benefits and Costs

Regardless of whether development alternatives and/or mitigation options are carried out, the inclusion of this requirement will facilitate the development of a statewide accounting mechanism for GHG impact of compact development.

Feasibility Issues

Incorporating climate impact into SEPA review would be greatly complimented by similar requirements at the local government level (i.e. through comprehensive planning efforts).

Similar requirements should be made of transportation planning efforts (climate impacts for new transit and roads projects should be calculated as part of the approval process).

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

[54] Ewing, Reid, et al. Growing Cooler: The Evidence on Urban Development and Climate Change. October 2007. http://www.smartgrowthamerica.org/gcindex.html

RCI-10 More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design

Mitigation Option Description

This option is designed to advance policies and programs that result in improved life-cycle benefits of new lighting, equipment, appliances and consumer electronic products, that is, through increasing energy efficiency while also increasing product recycling and reuse and avoiding the generation of solid waste and the production and emissions of toxic materials.

Washington is one of 10 states that have standards for minimum energy efficiencies for specific products not covered by federal standards, or that go beyond federal standards. State standards fill gaps left by the federal government or encourage the adoption by manufacturers and others of higher standards than current federal standards. Regional co-ordination for state appliance/equipment/lighting standards can be used to avoid concerns that retailers or manufacturers may (1) resist supplying equipment to one state that has advanced standards or (2) focus sales of lower efficiency models on a state with less stringent efficiency standards.

While there has been substantial progress in improving the energy efficiency of some consumer and commercial products, substantial energy conservation potential remains in products such as lighting, computers, servers and televisions. And equally important to moving the consumer electronic product industry to increased energy efficiency is to reduce the life-cycle environmental and economic impacts of the next generation of lighting, appliances and other electronic and electrical equipment.

The overall goal of this option is to reduce the life-cycle greenhouse gas (and other) emissions—that is, the "footprint"—of products and their packaging. Additional benefits include reducing non-GHG pollutants and saving materials. This option would include appliance and lighting products recycling; design issues such as including "smart chips" in products, and designing products to make them last longer and be easier to recycle.

Mitigation Option Design

Elements of this option include:

- Task CTED with adopting California's efficiency standard for televisions, that is, power consumption of a maximum of 3 watts in passive mode (and provide funding and staffing support to enable CTED and other agencies to implement this and other elements).
- Develop and implement minimum efficiency standards for televisions in "active mode"[55], digital TV adapters and other consumer electronic goods, working with US DOE or other parties.

[55] Already, televisions account for about 4 percent of annual residential electricity use in the United States. By 2009, when half of all new TV sales are expected to be extended- or high-definition digital sets with big screens, according to NRDC, TV energy use will be about 50 percent higher than at present. Further, the move to high-definition TV requires sets to deliver more picture clarity, which uses more power. In addition, nationally it is anticipated that

- Task CTED with analyzing the potential to apply efficiency standards to include lighting products. California is currently considering legislation requiring minimum lumen/watt standards for different categories of lighting as well as setting standards for reducing indoor residential lighting energy usage by no less than 50%, by 2018, as well as requiring a 25% reduction in commercial facilities by that same date.
- Task CTED to review and analyze efficiency standards already adopted by California (products not covered by federal standards) for application in Washington including walk-in refrigerators and freezers, residential furnaces, dry-type transformers, commercial hot-food holding cabinets and other electronic and electrical equipment.
- Task CTED with reporting to the governor and legislature on the level of wholesale and retail compliance with the state's appliance efficiency standards.
- Require (through state legislation) manufacturers to reduce the levels of toxins in lighting products, such as mercury in fluorescents, consistent with requirements already in place in the European Union.
- Require (through state legislation) manufacturers to have an effective system in place for collecting and recycling end-of-life bulbs that contain hazardous materials that is easy and convenient for the consumer[56]. This can be done by including the cost of collection and recycling in the purchase price of the product and by working with retailers, recyclers, utilities, local governments and others to provide convenient collection opportunities. Manufacturer-designed and -financed systems would ensure the most efficient and effective collection programs.
- Concurrent with policies and programs to ensure safe recycling and/or disposal of lighting products that contain lead and mercury, phase out incandescent lighting and set a date for a ban on them (with appropriate exemptions such as surgeries.)
- With state, utility and private sector financial support, invest in research and development initiatives or incentive programs to accelerate the use of LED (light-emitting diode) and other least toxic, highly-efficient lighting technologies in all sectors.
- Require (through state legislation) the preferential procurement of EnergyStar™ products if available (equipment, appliance or technology) if state funds are involved (e.g., state purchasing contracts, state grants or loans, etc.)
- Create state tax incentives to increase sales and use of EnergyStar™ appliances and equipment.
- Work with manufacturers, retailers, recyclers and energy and solid waste utilities to ensure that all program elements promote and incorporate the recycling and/or materials reuse of old products (including increasing the use of recycled materials in manufacturing new products), and

millions of old analog televisions will be no longer wanted and will need to be recycled. Using the best available technology, however, could reduce this new generation of big-screen TV "active mode" consumption by at least 25 percent, saving 10 billion kilowatt-hours per year, the NRDC estimates. In addition to chopping residential electric bills by $1 billion, it would prevent 7 million extra tons of carbon dioxide from entering the atmosphere, according to NRDC (see, for example, http://www.nrdc.org/air/energy/energyeff/tv.pdf).

[56] For example, transitioning from incandescent lighting to CFLs in the residential sector offers enormous energy savings potential, but the fact that there is no comprehensive and effective system in place for recycling or disposing of old CFLs to avoid mercury contamination creates a barrier to achieving the full potential of CFLs.

to implement lower-energy manufacturing processes. Energy efficient product promotional programs should be planned and coupled with corresponding recycling programs for the old products and new products being promoted. Also consider encouraging manufacturers to design product/packaging for use as clean fuel if not reused or recycled.

- Require, through state legislation, TV manufacturers/distributors to rate the energy use of TV units sold, and to display rating results at point of sale.
- Substantially increase the use of green electronic products and reduce solid waste by promoting EPEAT™ through a consortium of state, local government and business procurement entities, and require the use of EPEAT in state and local government procurement[57].

To achieve economies of scale and market efficiency, many of the most promising mitigation options would be most effective if planned and developed regionally, through, for example, the Western Climate Initiative. That said, however, it is important for Washington and other individual states to press forward with new appliance/equipment/lighting efficiency standards, and with related standards for the environmental impacts of products, as doing so will accelerate the move toward higher regional and national standards, and will play a key role in educating consumers.

Goals:

- Consistent with an option being developed by the Agriculture/Waste TWG (AW-3), the recycling/collection goal should be 50% at a minimum; the capture rate for toxic, banned or highly recyclable products should be higher; ultimately, the state's interest should be 100% capture rate for these products.
- The energy savings goal for improved lighting efficiency is 50% in the residential sector and 25% in the commercial sector.
- Goals for the other products should be set based on an analysis of the baseline energy use and conservation potential, except for TVs.
- The goal for TVs should be to improve energy use efficiency of the new generation of TVs by 25%.

Timing: Implement analyses noted above by 2008; design additional efficiency standards by 2009 and implement by 2010; begin implementing coordination on recycling and take-back programs in 2010.

Coverage of parties: Consumers, Manufacturers, Retailers, Solid Waste Agencies, other State Government Agencies

Other: None cited.

Implementation Mechanisms

In addition to the design elements noted above, implementation mechanisms for elements of this option could include:

[57] EPEAT is The Electronic Product Environmental Assessment Tool—see, for example, http://www.epeat.net/.

- Appliance/equipment/lighting efficiency standards can be implemented at the state level for appliances and other devices not covered by federal standards, or where higher-than-federal standard efficiency requirements are appropriate[58].
- Consideration of potential shifts in the use of toxic materials (such as mercury in fluorescent lamps) that could inhibit consumer demand for the efficient appliances and create costly disposal issues. For example, efficiency standards policies could be linked to manufacturer “takeback” requirements, toxics reduction standards, or incentives for development and use of non-toxic technologies.
- Consideration of “waste-to-fuel” issues in product and packaging design, with the goal of reducing the life-cycle greenhouse gas (and other) emissions “footprint” of products and their packaging by assuring that the product/packaging can be easily converted to a clean-burning fuel (if not reused or recycled) by eliminating impurities.
- Substantially increase the use of green electronic products and reduce solid waste by promoting EPEAT™ through a consortium of state, local government and business procurement entities. EPEAT *(The Electronic Product Environmental Assessment Tool—see, for example, http://www.epeat.net/)* is a procurement tool and system in which manufacturers declare their products’ conformance to a comprehensive set of environmental criteria in eight environmental performance categories including reduction/elimination of environmentally sensitive materials, material selection, design for end of life, product longevity/life cycle extension, energy efficiency, packaging and corporate performance. Provide state funding to promote EPEAT.
- Provide incentives for manufacturers to improvement the energy efficiency of products, the efficiency with which products can be produced, and the degree to which products can be recycled.
- Consider the impact of the standards and requirements included in this option on lower-income groups, and consider ways to mitigate those impacts.

Related Policies/Programs in Place

State and federal appliance standards passed since 2005 will produce about 0.08 MMtCO_2e of GHG emissions savings toward Washington’s 2020 target.[59]

In 2005 the Washington Legislature adopted minimum efficiency standards for 12 products (RCW 19.260.040). State standards for four of these products were eliminated in 2006 legislation after stricter federal standards were established for those products. 2006 legislation established minimum efficiency standards for 8 types of commercial appliances, heating/cooling and lighting equipment sold within the State

CTED is authorized by statute to update and recommend standards not covered by federal standards under the following conditions: if the alternative products are being produced, are cost effective, have equal or improved utility, and if the standards already exist in at least two states.

[58] In recent years, Arizona, Oregon, and Washington, among other states, adopted state standards for several appliances; this led to the inclusion of standards for these appliances in the 2005 federal Energy bill.

[59] At this writing, federal legislation under consideration will result in new efficiency standards for refrigerators, dishwashers, washing machines and dehumidifiers.

Electronic Product Recycling Program: The Washington State Legislature passed legislation in 2006 requiring the manufacturers of televisions, computers, laptops and monitors to establish and finance a system throughout the state for the collection and recycling of those products by January 1, 2009.

Washington State Environmentally Preferable Purchasing Policies: The State of Washington has a broad legislative and policy mandate for environmentally preferable purchasing activities by state agencies, including:

- Executive Order 02-03, Sustainable Practices by State Agencies calls for each state agency to establish sustainability objectives and modify their purchasing practices in order to:
    - minimize energy and water use
    - shift to clean energy for both facilities and vehicles
    - shift to non-toxic, recycled and remanufactured materials in purchasing and construction
    - expand markets for environmentally preferable products and services
    - reduce and eliminate waste
- Executive Order 05-01, Establishing Sustainability and Efficiency Goals for State Operations directs state agencies to achieve specific sustainability goals and required actions such as green building standards, reduction in petroleum use, etc. and:
    - significantly reduce office paper purchases by 30%, increase the purchase of environmentally preferable paper to at least 50%, recycle all used office paper, and increase the purchase of post-consumer recycled janitorial products
- Executive Order 04-01, Persistent Toxic Chemicals, directs state agencies to take steps to reduce persistent toxic chemicals in Washington State's environment.
- RCW 43.19 GA's enabling legislation, provides a broad legislative basis for state purchases of recycled content and energy saving products. It also provides the flexibility to allow GA to award state contracts based on environmental considerations. It establishes that factors beyond price, including past performance and life cycle costing, are to be used in determining the "lowest responsible bidder."
- RCW 43.19A includes goals requirements to increase the purchase and use of recycled content products. RCW 43.19.530A requires a chain of custody record that documents to whom the products were initially delivered through to the end use manufacturer.
    - Chapter 70.95M RCW The Mercury Education Reduction Act (MERA) mandates General Administration to give priority and preference to the purchase of equipment, supplies, and other products that contain no mercury-added compounds or components.

Type(s) of GHG Reductions

GHG benefits from this option will result predominantly from reduced CO_2 emissions from lower levels of natural gas fuel oil, and LPG consumption by more efficient appliances, and from reduced central-station fossil-fueled electricity generation caused by reduced end-user demand, in turn due to reduced demand for electricity use in appliances, lighting devices, and other equipment. Additional upstream CH_4 and CO_2 savings could occur due to incremental reduction in natural gas transmission, distribution, processing, and extraction activities. The increased reuse/recycling of products that is an element of this option will provide some reduction of energy-related emissions at the factories where products, and the raw materials that go into them, are produced. For paper, plastics, and other biodegradable materials, reduction in disposing of these materials in landfills will reduce methane emissions from these sites.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

Preliminary Results

		Reductions ($MMtCO_2e$)*			NPV (2008–2020) $ millions	Cost-Effectiveness $/tCO₂
	Policy	2012	2020	Cumulative Reductions (2008–2020)		
RCI-10	More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design	1.7	3.2	26.6	-$1075	-$40

Results by policy design element:

Design Element	Reductions ($MMtCO_2e$)		NPV (2008–2020) $ millions
	2012	2020	
Appliance/Equipment Standards (Excluding TVs) -Electricity Savings	0.2	0.6	-$92
Appliance/Equipment Standards (Excluding TVs) -Gas Savings	0.04	0.1	$53
Television Standards	0.1	0.2	-$37
Lighting Standards/Goal	1.4	2.3	-$352

Please see the Appendix to this document for additional details of inputs to, data sources used for, and results of the analysis of this option.

Data Sources:

See http://www.standardsasap.org/documents/leading_2006.htm for information on state-level opportunities for appliance and equipment efficiency standards. Note that more than a dozen states have adopted or are considering at least some—and in two cases, all but one—of the standards proposed by the Appliance Standards Awareness Project (ASAP). See http://www.standardsasap.org/state.htm for a summary of state adoption of these opportunities.

Quantification Methods:

Quantification Approach: Analysis focuses on the appliances/equipment/lighting standards element of this option by estimating the energy (electricity and gas) savings from 1) the package of code improvements analyzed for Washington by the ASAP and the American Council for an Energy-efficient Economy (ACEEE[60]), less overlapping savings from appliances and equipment standards already included in the package of "recent actions" evaluated for Washington as part of the CAT

[60] ASAP and ACEEE, 2006, "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", http://www.standardsasap.org/stateops.htm and http://www.standardsasap.org/a062_wa.pdf, and represent cost and savings for a package of appliance and equipment improvements, as estimated by the authors, for Washington State.

process; 2) improvements in television efficiency; and 3) lighting efficiency improvements. The GHG emissions benefits of recycling elements included in this option are not analyzed quantitatively here, as these benefits are covered in option AW-3, developed by the CAT's Agriculture and Waste TWG.

Key Assumptions:

ASAP estimates for first-year savings, by device, from its analysis of potential savings for new standards in Washington, have been adopted, along with product lifetime and cost estimates derived from the ASAP study. ASAP estimates include 12 options that save electricity and three that save natural gas.

- TV improvements are assumed to cover 100 percent of new and replacement TVs sold during the period of the program, and are assumed to result in a savings in annual energy use of 25 percent for those models.
- TV sales in Washington are assumed to track per-capita sales in the United States as a whole[61].
- TV efficiency improvements are assumed to cost $20 per lifetime MWh electricity saved on a lifetime basis.
- All residential and commercial lighting are assumed to be covered by the new standards.
- The fractions of residential and commercial electricity used for lighting are assumed to be 8.8% and 23.1%, respectively, based on data for the US as a whole.
- Lifetimes of Residential and Commercial lighting products are assumed to average 3 and 6 years, respectively.
- Levelized costs of Residential and Commercial lighting improvements are assumed to average 31 and 27 $ per lifetime MWh, respectively, based on analysis from the Energy Trust of Oregon[62].

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050): None cited.

Job Creation: Appliance manufacturing is generally not a Washington industry. Increased reuse/recycling of appliances does, however, create Washington jobs, as shipping units to be reused/recycled overseas (dismantling products, crushing, etc) is cost-prohibitive. (See also notes on Job Creation under RCI-1.)

Reduced Fuel Import Expenditures: None cited.

[61] Information on energy efficiency improvements and other data for the television efficiency analysis were taken from TELEVISIONS, Active Mode Energy Use and Opportunities for Energy Savings. Project Manager and Editor, Noah Horowitz, Natural Resources Defense Council; Authors, Peter Ostendorp, Suzanne Foster, and Chris Calwell, Ecos Consulting. Natural Resources Defense Council Issue Paper, March 2005. Available as http://www.nrdc.org/air/energy/energyeff/tv.pdf.

[62] ENERGY EFFICIENCY AND CONSERVATION MEASURE RESOURCE ASSESSMENT: Executive Summary of Results. Prepared for the Energy Trust of Oregon, Inc., Final Report, May 4, 2006. By Stellar Processes and Ecotope. Available as http://www.energytrust.org/library/reports/060508_RA_Executive_summary.pdf.

Key Uncertainties

According to experts, developing efficiency standards for televisions is proving to be especially challenging, so timing for capturing savings (or conversely, for forecasting increased energy use) is a major uncertainty. In the near term, education/awareness programs, including EnergyStar and other "rate/list/label" programs, may be the best and only opportunity to influence consumer choices toward more efficient products.

Additional Benefits and Costs

Additional benefits: Many energy saving appliances also result in substantial water savings (e.g., washing machines, dishwashers, spray-rinse valves)

Avoided release of toxic materials through recycling programs.

Feasibility Issues

None cited.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

RCI-11 Policies and/or Programs Specifically Targeting Non-energy GHG Emissions

Mitigation Option Description

GHG emissions from RCI sources not directly associated with energy use are emitted in relatively small quantities but have proportionately much larger impacts on climate. The potency of sources are measured by a global warming potential (GWP), - a measure of the potential impact of different gases on climate in terms of CO_2-equivalent. Below is a chart that shows the GWP for frequently-emitted GHGs.

Greenhouse gas	**Global Warming Potential (relative to CO_2)**
Carbon dioxide (CO_2)	1
Methane (CH_4)	23
Nitrous oxide	296
Hydrofluorocarbons (HFCs)	120 -12,000
Perfluorocarbons (PFCs)	5,700 – 11,900
Sulfur hexafluoride (SF_6)	22,200

Third Annual Assessment, IPCC 2001

A combination of voluntary agreements with industries and of new specifications for key equipment can be used to reduce the emissions of process gases that have high global warming potentials.

Mitigation Option Design

The sources of GHG emissions not directly associated with energy use generally fall into five categories:

- CO_2 from non-fossil fuel combustion sources. One percent of Washington's CO_2 emissions come from the non-energy aspects of aluminum and cement production.
- Methane (CH_4) from landfills, coalmines, oil and gas operations and agriculture accounts for less than 3% of Washington's emissions currently, but are projected to increase slightly (less than 1 $MMtCO_2e$ from 2005 to 2020.) Mitigation policies addressing CH_4 are addressed by the Agriculture TWG.
- Agricultural activities such as manure management, fertilizer use, and livestock (enteric fermentation) result in methane and nitrous oxide emissions that account for 6% of State GHG emissions in 2005. These emissions are projected to decrease by about 0.6 $MMtCO_2e$. Mitigation strategies are addressed in the Agriculture and Waste TWG.
- Hydrofluorocarbon (HFCs) and perfluorocompounds (PFCs) also known as Ozone Depleting Substitutes (ODS), are potent greenhouse gases that comprise a small but growing source of GHG emissions in Washington state and nationally. ODS are used in refrigeration, air conditioning and in heat pumps. "Even low amounts of HFC and PFC emissions, for example,

from leaks and other releases associated with normal use of the products, can lead to high GHG emissions on a carbon-equivalent basis." Washington's ODS emissions are expected to increase at an average rate of 6.1 percent per year from 2000 to 2020. The GWP of HFC-134a, one example of a HFC is 16,500 times more potent than CO_2 over a 100-year period.

- Sulfur hexafluoride (SF_6) is a GHG used for insulation in the electricity industry and is emitted mostly when electric power transmission and distribution systems malfunction. According to the Intergovernmental Panel on Climate Change, SF_6 is the most potent greenhouse gas ever evaluated. It has a global warming potential of ***22,200 times CO_2 over a 100-year period***. SF_6 emissions have declined because of voluntary industry action in the 1990s. SF_6 emissions will continue to decline as utilities improve their ongoing leak detection and recycling efforts.

The mitigation options for this policy span across different sectors and industries. A combination of voluntary reduction, requirements for key equipment, education campaigns, performance standards, and prescriptive measures can be used. Reduction strategies are divided by the industry and source targeted for mitigation.

Aluminum and Cement Production

The cement and aluminum industry are the highest emitters of non-energy CO_2. Large quantities of CO_2 are emitted during the production of lime, the key ingredient in cement. GHG emissions from these industries can be reduced in various ways, and can make a large dent in overall CO_2 reduction. Options for reducing emissions in the cement industry, for example, are inclusion of fly ash in cement, and use of innovative low-GHG cement fillers. Key elements of this option include:

Goals: Reduce CO_2 emissions by the cement and aluminum industries. A 10 percent reduction in CO_2 emissions per ton of cementitious product produced or sold from a 1990 baseline by 2020.

Timing: Implement policy in a reasonable timeframe to allow timely reductions.

Coverage of parties: All industrial sources currently monitored by the GHG inventory, and emit over 100,000 metric tons of CO_2e, are covered by this mitigation option.

Other: None cited.

HFCs and PFCs

Efforts to reduce the use of ODS products are necessary to decrease the potential growth of the powerful greenhouse gases. Refrigeration and mobile air conditioning (MAC) release the highest amounts of ODS. HFCs are also found in compressed gas computer keyboard canisters, which are 100% HFC-134a, and in novelty aerosols such as silly string. Key elements of state action should include:

- Overall provisions
- Provisions for mobile air conditioning
- Provisions for refrigeration, air condition and heat pump equipment

Goals: Reduce the use of HFCs and PFCs

Timing: Implement policy in a reasonable timeframe to allow timely reductions.

Coverage of parties: Individuals and industry are both covered in this mitigation strategy.

Other: None cited.

Electrical Power Systems

The largest emissions of SF_6 are from routine maintenance and equipment installation in the electrical power industry. In order to reduce levels of SF_6 emissions and to mitigate increased use of SF_6 because of the growth in the demand for electricity, it is imperative to implement SF_6 emissions-reducing policies. There are various policies to reduce leakage of SF_6 emissions and increase SF_6 recycling, such as leak detection (infrared systems), leak repair, and recycling of components.

Goals: Reduce the emissions of SF_6 in the electric power system industry.

Timing: Implement policy in a reasonable timeframe to allow timely reductions.

Coverage of parties: Electric power industry.

Other: None cited.

Implementation Mechanisms

In addition to the design elements noted above, possible implementation mechanisms for elements of this option include:

Cement Production:

In addition to measures that reduce fossil fuel energy use per unit of production in RCI-2, the following are recommended:

- Work with the cement industry to promote the development of cement-production techniques that require a lower proportion of calcined materials, thereby reducing CO_2 emissions per unit of product.
- Ensure that State construction specifications (DOT, GSA, etc) support the U.S. cement industry's support for changes to the standard recipe for Portland cement developed by the American Society for Testing and Materials (ASTM) to allow intergrinding some uncalcined limestone into the finished product to reduce the proportion of clinker in the finished product. Acceptance of such a change would result in a significant reduction of CO_2 emissions per unit of cement. Switching to different cement types that offer lower CO_2 emissions should be encouraged by the agencies that set building/highway project guidelines. The DOT and GSA have used cements blended so as to reduce GHG emissions, though some agencies, including at the local level, should be further encouraged to do so.

- Ensure that state procurement officials and policies support the harmonization of ASTM and AASHTO Cement Standards[63]
- Develop state procurement standards to increase use of climate friendly cement.
- Promote the life-cycle benefits of concrete use to architects, builders, state and federal procurement officials.
- Consider tax benefits and other incentives for applications of concrete products for paving and building that demonstrate positive life-cycle attributes.
- Participate in ongoing programs such as the U.S. Green Building Council, DOE's Industrial Technologies Program, and ENERGY STAR.
- Support for DOT and other government agencies' adoption of performance standards as an alternative to more prescriptive standards where applicable--for example, for building materials production processes that emit carbon, base emissions standards on the structural capacity of a product, rather than its mass alone—so manufacturers have the flexibility to shift to more low-energy products and encourage substitution. This could include using blast-furnace slag *as* an alternative input in road construction.
- Requirements that cement users (or contractors working under building permits) have a certain percentage of fly ash or other material in the concrete they pour. This reduces the amount of cement used.
- Financial and/or market incentives to change the way cement is made (for example, where appropriate to switch to environmentally innovative fillers such as sewage).

<u>HFCs and PFCs</u>

- Restrict the use of ODS in situations where viable alternatives are available.
- Use a combination of consumer education and labeling programs (for example, like those proposed under RCI-8) to provide information about the greenhouse gas emissions consequences of using consumer products containing HFCs and other ODS[64].
- As part of the Western Climate Initiative, negotiate a cap on HFCs and PFCs. A cap would provide some security against runaway emissions, and would allow flexibility for actions beneath the capped level.
- As part of the Western Climate Initiative, develop model legislation to prohibit:
    - Windows containing fluorinated gases
    - One component foams containing fluorinated gases
    - Novelty aerosols containing fluorinated gases

[63] Some states use a Portland cement standard developed by the American Association of State Highway Transportation Organizations, rather than the ASTM standard. After the ASTM standard is improved, the AASHTO standard should be changed to conform.

[64] Aerosol computer keyboard cleaners containing HFCs release significant GHG CO_2e when used, and are an example of a product to which a combination of education and labeling programs might apply.

   - Non-confined direct-evaporation systems which use ODS gases as the refrigerant

- Create state procurement standards that declare a presumption against the use of HFCs and PFCs; they should be eliminated when technically feasible. The standards can serve as models for local governments, business and institutions.
- Launch a campaign aimed primarily at consumers and secondarily at retailers of personal technical products containing ODS. This option has the goal to encourage distributors and manufacturers to phase out the use of consumer aerosol ODS products.

Mobile Air Conditioning

- Adopt a policy that adds any refrigerant with a GWP of 150 or more to the EPA phase-out schedule for refrigerants in mobile air conditioners (MAC). As a party to the Montreal Protocol, the United States has already agreed to meet Protocol limits by phasing-out HCFC-141b, HCFC-142b and HCFC-22, the most damaging of the HCFCs. WA can use current EPA regulations to model extended product phase out.
- Join with the Society of Automotive Engineers (SAE), the European Union, and the California Air Resources Board to adopt common testing and engineering standards for existing MAC.
- Ensure that state fleet managers follow the recommendations of EPA's Mobile Air Conditioning Climate Protection Partnership. Work with local governments, Clean Air Agencies and the Clean Cities Coalition to promote the Partnership. The Partnership recommends:
   - More efficient refrigerant recovery and more accurate charging equipment and procedures.
   - Improved leak detection (tools and procedures).
   - Mandatory repair of A/C system leaks before system recharge.
   - Quality components; correct installation and connections.
   - Reduction of emissions from refrigerant container heels.
   - Elimination of DIY recharge of leaking systems.
   - Better compliance with recovery requirements and more efficient recovery at vehicle end of life.
   - Restricting sale of refrigerant only to certified technicians.

Commercial refrigeration, air condition and heat pump equipment

- Consider adopting regulations similar to those in the EU, specifically:
   - Regulate the containment, leakage, use, recovery of ODS, using labeling, reporting, prohibition, and training for servicing personnel and operators.

- All owners of equipment and fire protection systems containing 300 kilograms or more of fluorinated gas are required to install leak detection systems.
- For systems less than 300 kilograms, appliances will be checked for leaks once a year, or every six months depending on the amount of gas.

SF_6

- Commission a study to consider whether utility SF6 control/management should move from voluntary initiatives to mandatory. For example, as part of the annual fuel mix disclosure requirements of RCW.29A, utilities could be required to report annual SF6 emissions and current policies and programs to reduce them.
- Urge all state electric utilities that do not already participate to join the EPA SF6 Reduction Partnership for Electric Power Systems.

Related Policies/Programs in Place

Aluminum and Cement Production

Actions directed at the Aluminum and Cement production industry reductions can model the Environmental Protection Agency's voluntary aluminum industrial partnership (VAIP). Companies that participate in this program agree to report GHG emissions to create a baseline and report on estimated reductions. This program also monitors PFCs. The state mitigation option would expand this program, make it mandatory and add standards and/or requirements above.

There is a National Performance Standard for Cement production based on the performance of the maximum achievable control technology (MACT) and standards for hydrocarbons and hazardous air pollutants. The state mitigation option could build upon this program and add standards and requirements for GHG pollutants.

HFCs and PFCs

The European Commission has a directive to reduce HFCs, PFCs and sulfur hexafluoride (F-gases). The directive bans all F-gases with a GWP of more than 150 for new models.

The Commission also regulates commercial refrigeration though reduction, leakage control and restrictions on F-gases use. More information on this program and details of policy implementation can be found at, http://ec.europa.eu/environment/climat/doc.htm.

SF_6

The EPA administers SF_6 Emission reduction partnership for electric power systems. The partnership works to identify and implement cost effective solutions to reduce SF_6 emissions. Eighty-one utilities participate in the program, including Seattle City Light, Pacificorp, and Public Utility District #1 of Douglass and Pend Oreille Counties.

Type(s) of GHG Reductions

Significant reductions of CO_2, HFC, PFC and SF_6 could be achieved by the policy options above. Reductions of the various GHG species would occur based on which sectors and products the policy is designed to influence.

Estimated GHG Savings (in 2020) and Costs per MtCO2e

Preliminary Results

		Reductions ($MMtCO_2e$)*			NPV (2008–2020) $ millions	Cost-Effective-ness $/tCO_2$
	Policy	**2012**	**2020**	**Cumulative Reductions (2008–2020)**		
RCI-11	Policies and/or Programs Specifically Targeting Non-energy GHG Emissions	0.3	1.5	7.8	$5	$1

Results by policy design element:

Design Element	Reductions ($MMtCO_2e$) 2012	2020	NPV (2008–2020) $ millions
Savings from reduction of CO_2 Emissions from Cement Manufacturing	0.02	0.1	-$3
Savings from reduction of CO_2 Emissions Aluminum Manufacturing	0.0	0.0	$0
Cost of Savings from Reduced Use/Emissions of ODS Substitutes	0.2	1.3	$7
Cost of Savings from SF_6 Emissions Reduction in Electric Utility Industry	0.04	0.1	$1

Data Sources:

King Country has prepared an analysis of the use of blast-furnace slag and fly ash in road construction. The City of Seattle is currently preparing a similar analysis.

Quantification Methods:

Quantification Approach: Four specific types of non-energy GHG reductions are proposed in this option—CO_2 emissions from cement manufacture, CO_2 emissions from aluminum manufacture, reduction of emissions from non-CFC ODS use, and reduction of SF_6 from electric utility operations. To estimate the reductions from changes in the cement industry, the 10 percent reduction goal noted above is phased in from the start of the program through 2020, and applied to the existing projection of WA CO_2 emissions from this source. A study on the costs of different methods of reducing CO_2 emissions from cement manufacture was used to estimate the net costs of reduction (see Appendix for sources). A similar approach has been developed for use in estimating reductions in non-energy CO_2 emissions from the aluminum industry (that is, CO2 released during the process of reducing aluminum oxide to metallic aluminum), but sources of data on the cost and performance of measures to reduce these emissions have not yet been identified. To estimate reductions from changes in the use of ODS substitutes for refrigeration, air conditioning, the costs and fractional savings results of set of measures evaluated in a recent study for California, suggesting savings of about 25 percent of projected emissions at a cost of about $1.60 per $MTCO_2e$ avoided, were adapted for Washington, and applied to the projection for emissions from ODS substitutes included in the Inventory and Forecast to estimate emissions reduction [65]. Data from the same California study were applied to projected Washington

[65] Emission Reduction Opportunities for Non-CO_2 Greenhouse Gases in California. Prepared for the California Energy Commission (CEC) Public Interest Energy Research Program by: ICF Consulting, and dated July 2005 (report # CEC-500-2005-121).

emissions of SF_6 from the utility industry to calculate emissions savings, assuming an emissions reduction of 80 percent[66] at a net cost of $3.4 per $MTCO_2e$ avoided.

Key Assumptions: See text above and notes in Appendix**.**

Contribution to Other Goals

Contribution to Long-term GHG Emission Goals (2035/2050):

Emissions from the use of ODS substitutes are a growing fraction of US and global GHG emissions; measures to avoid these emissions, through capture or development of lower GHG alternatives could have significant long term benefits.

Job Creation: Impact uncertain.

Reduced Fuel Import Expenditures: Impact uncertain.

Key Uncertainties

At present there is not enough blast furnace slag and fly ash produced in Washington to supply all of what the state could use for road construction and other emissions-reduction strategies. Transport from other places, including Alberta, and even China (as ballast in freighters) is possible, but analysis of the net impacts of transporting and using these materials is needed.

Many uncertainties regarding future emissions of non- CO_2 gases exist. There is large scientific uncertainty about the relative climate changing properties of the various gases and aerosols addressed above. There is also uncertainty in how effectively these gases can be monitored, registered and regulated.

There is consensus, however, that control of non-CO_2 gases is necessary and should be considered as a component of a cost effective climate policy. The Pew Center on Global Climate Change completed a report that addresses the key uncertainties in mitigating "Multi-Gas Contributors to Global Climate Change". Information on this topic and the full study can be found at: http://www.pewclimate.org/global-warming-in-depth/all_reports/multi_gas_contributors/

Additional Benefits and Costs

Reduction in the use of calcined material in cement products can avoid impacts from the extraction of raw materials (e.g. limestone mining).

The California Energy Commission, in partnership with the public Interests Energy Research Program, released a report, "Emission Reduction Opportunities for Non- CO_2 Greenhouse Gases in CA". This report addresses the benefits and costs of controlling non-CO_2 GHG emissions, and can be found at: http://www.energy.ca.gov/pier/final_project_reports/CEC-500-2005-121.html.

Feasibility Issues

[66] Note that the source document assumed a reduction of SF_6 emissions of 100 percent. A lower figure was used here, as complete elimination of these emissions seemed unrealistic.

Many policy options are addressed above. Some of the policies have been effective elsewhere in the United States and internationally. In many cases expansion of existing programs is recommended. The feasibility of policies that have been adopted elsewhere can be expected to be higher than those for policy options that have not been implemented in other places.

The feasibility of individual policy options can be expected to range widely depending, in part, on the level of effort put into the mitigation program.

Status of Group Approval

TBD

Level of Group Support

TBD

Barriers to Consensus

TBD

APPENDIX - Additional Analysis Details for Preliminary Analyses

Common Assumptions for Washington RCI GHG Analysis

Date Last Modified: 11/9/2007 D. Von Hippel/C. Lee

Common Assumptions

Real Discount Rate	5%	
Levelized, Avoided Costs (2008-2020, 2005$)		
Electricity	$ 64.20	$/MWh
New estimate based on ES TWG decision (Nov 7 meeting), based on Avista avoided cost analysis as described in ES-1. Previous estimate of $43.46/MWh derived from NWPCC data from RTF analysis, same source as marginal CO2 emission rate for electricity reductions, this is the simple average (not levelized value) of the marginal dispatch costs for 2010, 2015, and 2020.		
Electricity - Residential	$64	$/MWh
Electricity - Commercial	$64	$/MWh
Electricity - Industrial	$64	$/MWh
Levelized Costs not differentiated by sector for this analysis.		
Natural Gas	$6.8	$/MMBtu
Levelized costs, 2008 to 2020. 2005 cost from EIA data for "City Gate" prices in WA (from http://tonto.eia.doe.gov/dnav/ng/ng_pri_sum_dcu_SMT_a.htm), escalated based on AEO2006 natural gas price projections.		
Prices		
Electricity Price - Sales-Weighted, Levelized	$59	$/MWh
Prices are based on DOE data for prices in 2005 http://www.eia.doe.gov/cneaf/electricity/esr/esr_sum.html. Changes from 2008 to 2020 are based on the relative changes in projected SERC reliability Corporation region prices in US DOE Annual Energy Outlook 2006 (same % changes). AEO 2006 projects prices to declining to below 2005 levels from 2008 onward.		
Electricity - Residential Prices (Levelized, 2008-2020)	$66	$/MWh
Electricity - Commercial Prices (Levelized, 2008-2020)	$60	$/MWh
Electricity - Industrial Prices (Levelized, 2008-2020)	$45	$/MWh
Natural Gas (Delivered, RCI sales-weighted average)	$10.3	$/MMBtu
Natural gas prices are estimated as described for electricity above.		
Natural Gas - Residential Prices (Levelized, 2008-2020)	$11.4	$/MMBtu
Natural Gas - Commercial Prices (Levelized, 2008-2020)	$10.0	$/MMBtu
Natural Gas - IndustrialPrices (Levelized, 2008-2020)	$9.3	$/MMBtu
Biomass - All Users	$3.3	$/MMBtu
	$52.9	$/dry ton
Based on mix of resources (forest biomass and mill residues) as reported in the F TWG (options F-6, and F-7)		
Coal - Industrial Users	$2.2	$/MMBtu
average coal heat content of 23.18 MMBTU/ton, based on USDOE/EIA data (http://www.eia.doe.gov/emeu/states/sep_use/notes/use_b.pdf). USDOE/EIA coal consumption figures for 2005 "other industrial users" are withheld for WA. A "Pacific" (West Coast) average coal price of $50.62 per ton is given for "Other Industrial Users" in http://www.eia.doe.gov/cneaf/coal/page/acr/table34.html. By contrast, the "Other Industrial Users" value for Idaho is given as $37.07.		
Oil - Distillate/Diesel	$9.5	$/MMBtu
Levelized costs, 2008 to 2020. USDOE/EIA data are not available for WA or PADD IV. USDOE/EIA data provide US average price wholesale price for heating oil of $1.72 per gallon in 2005/06 heating season. This cost does not include fuel taxes. An appendix to the 2006 Annual Energy Outlook by USDOE/EIA (see http://www.eia.doe.gov/oiaf/aeo/pdf/appendixes.pdf) lists an energy content for distillate oil of 5.799 MMBtu/bbl, or 0.138 MMBtu/gallon. Cost computed used for 2006 price, which is escalated using the trends from AEO2006 distillate oil prices for the Pacific region (see "AEO2006 worksheet in this workbook).		
LPG	$8.4	$/MMBtu
Levelized costs, 2008 to 2020. USDOE/EIA data are not available for WA. The US average wholesale price given by USDOE/EIA for propane is $1.01 per gallon in the 2005/06 heating season. This cost does not include fuel taxes. Prices expressed on $/MMBtu basis a conversion factor of 0.09133 MMBtu/gallon (see "Fuel Data" woksheet). Cost computed used for 2006 price, which is escalated using the trends from AEO2006 distillate oil prices for the Pacific region (see "AEO2006 worksheet in this workbook).		
Landfill Gas - All Users	$5.0	$/MMBtu
Placeholder Estimate		
Biogas Gas - All Users	$5.0	$/MMBtu
Placeholder Estimate		

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

GHG Emissions Totals for Washington RCI GHG Analysis

Date Last Modified:	11/20/2007	D. Von Hippel/C. Lee

Summary Interim Results and Totals for RCI Mitigation Options

	Option Name	GHG Reductions ($MMtCO_2e$) 2012	GHG Reductions ($MMtCO_2e$) 2020	Cost-Eff ($/$tCO_2e$)	NPV 2008-2020 ($million)	Cumulative Emissions Reductions (MMt CO_2e, 2008-2020)
RCI-1	Demand Side Management Programs Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil	0.60	2.77	-$32	-$498	15.6
RCI-2	Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds)	Not Quantified				
RCI-3	Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors	0.47	1.99	-$17	-$193	11.5
RCI-4	Energy Efficiency Improvement in Existing Buildings, with Empahsis on Buidling Operations	0.99	4.16	-$22	-$529	24.2
RCI-5	Rate Structures and Technologies to Promote Reduced GHG Emissions	0.28	0.30	-$78	-$226	2.9
RCI-6	Provide Incentives to Promote and Reduction of Barriers to Implementation of Renewable Energy Systems	Quantified as ES-2				
RCI-7	Provide Incentives and Resources to Promote and Reduction of Barriers to Implementation of Combined Heat and Power and Waste Heat Capture, Inclduing Net-metering for Combined Heat and Power	Quantified as ES-7				
RCI-8		Not Quantified				
RCI-9		Not Quantified				
RCI-10	More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design	1.71	3.22	-$40	-$1,075	26.6
RCI-11	Policies and/or Programs Specifically Targeting Non-energy GHG Emissions	0.29	1.47	$1	$5	7.8
	Total Gross Savings	4.3	13.9	-$28	-$2,515	88.5

Adjustment for Estimated Overlap Between RCI Options and with Recent Actions						
Overlap between RCI Options						
RCI-1, Overlap with RCI-3 and RCI-4	0.30	1.38		-$249	7.8	***See Note 1***
RCI-3 overlap with Recent Actions	0.31	1.31		-$204	7.6	***See Note 2***
RCI-4 overlap with Recent Actions	0.39	1.64		-$324	9.6	***See Note 2***
RCI-5 Overlap with Other Quantified Policies	0.00	0.00		$0	0.0	***See Note 3***
RCI-6, Overlap with Other Quantified Policies	See Energy Supply Results					
RCI-7, Overlap with Other Quantified Policies	See Energy Supply Results					
RCI-8, Overlap with Other Quantified Policies	Not Quantified					
RCI-9, Overlap with Other Quantified Policies	Not Quantified					
RCI-10 Overlap with Other Quantified Policies	1.37	2.57		-$860	21.2	***See Note 4***
RCI-11 Overlap with Other Quantified Policies	0.00	0.00		$0	0.0	***See Note 5***
Total Estimated Overlap Among RCI Policies	2.37	6.91		-$1,637	46.2	
Total Savings Net of Overlaps	1.97	7.00	-$21	-$878	42.2	

Additional Emissions Savings from Recent Actions (not included in forecast or in policy options above)

	Option Name	GHG Reductions ($MMtCO_2e$) 2012	2020		Cumulative Emissions Reductions ($MMt CO_2e$, 2008-2020)	
RCI-1	Existing Gas Utility DSM Spending	0.10	0.23		1.7	
	State green buildings--electricity savings	0.04	0.11		0.7	
	State green buildings--gas savings	0.03	0.09		0.6	
	Building Codes--electricity savings	0.14	0.28		2.3	
	Building Codes--gas savings	0.12	0.25		2.0	
	Appliance Efficiency Standards--electricity savings	0.30	0.45		4.4	
	Appliance Efficiency Standards--gas savings	0.05	0.07		0.7	
	I-937 Load Goals--electricity savings	1.84	3.94		30.7	
	Total	2.62	5.43		43.14	Total Recent Action
Total Emissions Reductions Net of Overlaps (including recent actions)		4.59	12.43		85.4	

TABLE BELOW SHOWS NET ADJUSTED SAVINGS BY OPTION

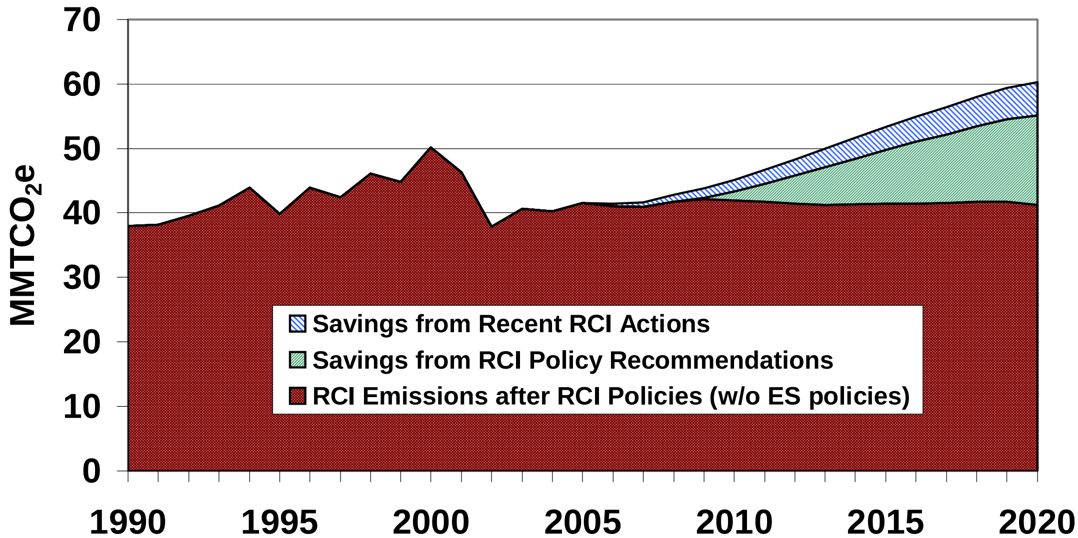
Summary Results and Totals for RCI Mitigation Options

	Option Name	GHG Reductions 2012	2020	Cost-Eff ($/tCO_2e)	NPV 2006-2020 ($million)	Cumulative Emissions Reductions ($MMt CO_2e$, 2008-2020)
RCI-1	Demand Side Management Programs Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil	0.30	1.38	-$32	-$249	7.8
RCI-2	Targeted Financial Incentives and Instruments to Encourage Energy Efficiency Improvements (Business Energy Tax Credit and Private/Public Efficiency Funds)	Not Quantified				
RCI-3	Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors	0.16	0.68	$3	$11	3.9
RCI-4	Energy Efficiency Improvement in Existing Buildings, with Empahsis on Buidling Operations	0.60	2.51	-$14	-$204	14.6
RCI-5	Rate Structures and Technologies to Promote Reduced GHG Emissions	0.28	0.30	-$78	-$226	2.9
RCI-6	Provide Incentives to Promote and Reduction of Barriers to Implementation of Renewable Energy Systems	See Energy Supply Results				
RCI-7	Provide Incentives and Resources to Promote and Reduction of Barriers to Implementation of Combined Heat and Power and Waste Heat Capture, Inclduing Net-metering for Combined Heat and Power	See Energy Supply Results				
RCI-10	More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design	0.34	0.64	-$40	-$215	5.3
RCI-11	Policies and/or Programs Specifically Targeting Non-energy GHG Emissions	0.29	1.47	$1	$5	7.8
	Total Savings	2.0	7.0	-$21	-$878	42

Compilation of Overlap-Adjusted Non-Electric Costs and Savings for Multi-TWG Results Summary

NOTE: Reductions and Savings below do not include green power or renewable energy components of RCI-3 or -4

Non-electric elements of RCI Options using:	GHG Reductions 2012	GHG Reductions 2020	Cost-Eff ($/t$CO_2$e)	NPV 2006-2020 ($million)	Emissions Reductions (MMt CO_2e, 2006-2020)
Savings Net of Overlaps	0.7	3.2		-$412	17.8



NOTES ON ESTIMATES OF OVERLAP BETWEEN POLICIES

Note 1:

RCI-1 likely includes measures that overlap with, and will be needed to provide, the savings that are a part of RCI-3 and RCI-4. We assume that as a result about 50% of RCI-1 savings overlap with other options.

Note 2:

The electricity savings from RCI-3 and RCI-4 will overlap with the savings from I-937 goals. We assume that approximately 50% of electricity savings for each option. comes from achieving I-937 goals (electric efficiency savings only--not solar PV or green power). An additional

27% of savings in RCI-3 savings in electricity use overlap with savings from building codes in existing actions, and
56% of savings in RCI-3 savings in gas use overlap with savings from building codes in existing actions.

Note 3:

RCI-5 savings can be expected to largely be associated with conservation of electricity by consumers, rather than from the addition of energy efficiency measures. The overlap with other options (and existing actions) is 0%

Note 4:

RCI-10 includes energy efficiency measure via standards that are expected to overlap substantially with I-937, RCI-3, and RCI-4--particularly the lighting efficiency measures in RCI-10. We assume that these overlaps account for approximately 80% of gross RCI-10 savings.

Note 5:

RCI-11 includes only non-energy emissions, and as such has 0% overlap with other options.

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

RCI-1 **Demand Side Management Programs Energy Efficiency Programs, Funds, or Goals for Natural Gas, Propane, and Fuel Oil**

Date Last Modified: 10/25/2007 C.Lee/D. Von Hippel

Key Data and Assumptions	2012	2020/all	Units
First Year Results Accrue		**2009**	
Current/expected utility efficiency spending			
Fraction of gas utility revenues spent on efficiency		**0.40%**	
Fraction of Propane (LPG) and Fuel Oil revenues spent on efficiency		**0.00%**	
*Gas utility fraction estimated as described in **Note 1**. Propane/Oil figure is a placeholder value, but is assumed to be near zero.*			
Year that action begins		**2007**	
Year that target is achieved		**2007**	
Following Assumptions Used for both Current/expected and New Programs			
Fraction of Statewide Natural Gas Sales Covered			
Residential		**100%**	Assumption
Commercial		**100%**	Assumption
Industrial		**100%**	Assumption
Fraction of Statewide Petroleum (LPG plus other oil products) Sales Covered			
Residential		**100%**	Assumption
Commercial		**100%**	Assumption
Industrial		**15%**	Assumption
Placeholder estimates. Industrial value takes into account that large shares of industrial fuel use in WA is "still gas" used in refineries (?) and petroleum coke use, both of which are probably not reasonable to cover under this type of DSM program. The 15% estimate for the industrial sector assumes roughly that distillate oil and LPG sales only are covered by the DSM program.			
Savings Targets			
Natural Gas			
Achievable cost-effective savings in natural gas use as a fraction of total gas demand:		**20.00%**	
Placeholder estimate.			
Fraction of achievable savings reached under program		**100%**	Option Goal
Year in which target fraction reached		**2020**	Option Goal
Year in which programs fully "ramped in"		**2012**	Assumption
Fraction of full program savings by year	100%	100%	
Implied fractional annual gas demand savings	1.9%	1.9%	
LPG and Fuel Oil		**20.00%**	
Placeholder estimate--assumed same as Natural Gas for now.			
Fraction of achievable savings reached under program		**100%**	Option Goal
Year in which target fraction reached		**2020**	Option Goal
Year in which programs fully "ramped in"		**2012**	Assumption
Fraction of full program savings by year	100%	100%	
Implied fractional annual gas demand savings	1.9%	1.9%	

Natural Gas Savings per Program Spending	**37,000**	MMBtu/yr per $million

The average savings from gas DSM programs reported in Tegen, S. and Geller, H., 2006. Natural Gas Demand-Side Management Programs: A National Survey, Southwest Energy Efficiency Project, www.swenergy.org, is approximately 72,700 Mcf/yr per million dollars, which is reported to include participants' shares of DSM costs. Information on gas DSM programs offered in WA by Puget Sound Energy (PSE, personal communications) suggests lower savings per unit investment--about 37,000 MMBtu/yr per million dollars invested in 2006. This lower figure is used here to better reflect local conditions, though it is recognized that the cost and cost-effectiveness of Gas DSM can vary substantially with program design and with programs, measures and sectors covered.

Oil/LPG Savings per Program Spending	**37,000**	MMBtu/yr per $million
Placeholder value--assumed same as natural gas for now.		
Levelized Cost of Natural Gas Savings	**$4.2**	$/MMBtu
Based on the first year costs above and average measure lifetime assumption below		
Assumed average measure lifetime	**8**	years
Avoided Delivered Natural Gas Cost	**$6.8**	$/MMBtu
See common assumptions		
Levelized Cost of LPG and Fuel Oil Savings	**$4.2**	$/MMBtu
Placeholder value--assumed same as natural gas for now.		
Assumed average measure lifetime	**8**	years
Avoided LPG Cost	**$8.4**	$/MMBtu
Avoided Distillate Oil Cost	**$9.5**	$/MMBtu
Approximate Weighted-average RCI Oil Products (including LPG) Cost for Covered Sales	**$9.1**	$/MMBtu

See common assumptions. Note that these costs are based on wholesale prices.

Other Data, Assumptions, Calculations	2012	2020/all	Units
Calculations used to estimate target spending levels			
During 2008-2020 period, implied new annual energy savings from:			
Current/expected gas utility spending	302	324	Billion Btu
Current/expected spending on fuel oil/LPG programs	0	0	Billion Btu
Meeting RCI-1 Savings Target--Natural Gas	1,977	4,568	Billion Btu
Meeting RCI-1 Savings Target--Oil Products (including LPG)	381	844	Billion Btu
Analysis			
RCI Gas Sales Covered *(from inventory)*	214,735	239,815	Billion Btu
Residential	84,448	91,339	Billion Btu
Commercial	52,594	57,111	Billion Btu
Industrial	77,693	91,365	Billion Btu
Conversion Factor: Million Btu per Thousand Cubic feet		1.03	MMBtu/Mcf
RCI Gas Prices (statewide averages, real 2005 dollars)			
Residential	$10.66	$10.40	$/MMBtu
Commercial	$9.38	$9.00	$/MMBtu
Industrial	$8.63	$8.21	$/MMBtu
2005 gas prices are from EIA (see "NGPrices current" worksheet in this workbook). http://tonto.eia.doe.gov/dnav/ng/xls/ng_sum_lsum_dcu_SNC_a.xls. Changes in sectoral gas prices indexed to future gas prices from DOE EIA Annual Energy Outlook 2006 national forecast.			
Total Implied Gas Revenues Covered (RCI, statewide)	$2,063	$2,214	$million
Residential	$900	$950	$million
Commercial	$493	$514	$million
Industrial	$670	$750	$million
RCI Oil Products (including LPG) Sales Covered *(from inventory)*	40,797	44,335	Billion Btu
Residential	16,144	17,735	Billion Btu
Commercial	5,905	5,900	Billion Btu
Industrial	18,747	20,700	Billion Btu
RCI Oil Products Prices (estimated averages, real 2005 dollars)			
Residential	$8.14	$8.12	$/MMBtu
Commercial	$8.38	$8.36	$/MMBtu
Industrial	$8.46	$8.44	$/MMBtu
Cost estimates based on 2005 distillate oil and LPG US wholesale prices, escalated using AEO2006 distillate oil price projections (DOE EIA Annual Energy Outlook 2006 national forecast).			
Total Implied Oil Products Revenues Covered (RCI, statewide)	$339	$368	$million
Residential	$131	$144	$million
Commercial	$49	$49	$million
Industrial	$159	$175	$million

Investment in Efficiency Programs

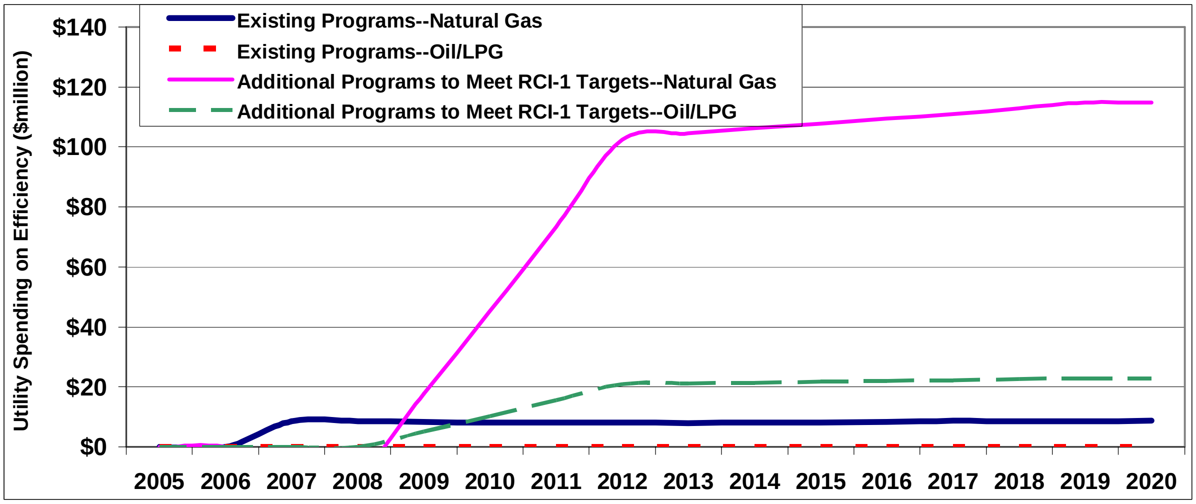
Current/expected utility efficiency spending			
Efficiency Spending, Natural Gas Utilities	$8.2	$8.7	$million
Fraction of Natural Gas Revenues Spent	0.40%	0.40%	
Efficiency Spending, fuel oil/LPG programs	$0.0	$0.0	$million
Fraction of fuel oil/LPG Revenues Spent	0.00%	0.00%	
Additional Investment to meet RCI-1 Savings Targets			
Efficiency Spending, Natural Gas Utilities	$102.4	$114.7	$million
Fraction of Natural Gas Revenues Spent	4.96%	5.18%	
Efficiency Spending, fuel oil/LPG programs	$21.0	$22.8	$million
Fraction of fuel oil/LPG Revenues Spent	6.19%	6.20%	

Additional Results	2012	2020	Units
Current/expected utility efficiency spending			
Reduction in Natural Gas Use (Cumulative)	1,857	4,356	Billion Btu
as % of overall projected sales in that year	0.60%	1.82%	
GHG Emission Savings, Natural Gas	**0.1**	**0.2**	$MMtCO_2e$
Reduction in Oil and LPG Use	0	0	Billion Btu
as % of overall projected sales in that year	0.00%	0.00%	
GHG Emission Savings, Oil and LPG Use	**0.0**	**0.0**	$MMtCO_2e$
Additional Investments to Meet RCI-1 Savings Target--Natural Gas			
Reduction in Gas Use (Cumulative)	2,333	41,436	Billion Btu
as % of overall projected sales in that year	1.12%	17.28%	
Incremental GHG Emission Savings, Natural Gas	**0.1**	**2.2**	$MMtCO_2e$
Additional Investments to Meet RCI-1 Savings Target--Fuel Oil/LPG			
Reduction in Fuel Use (Cumulative)	569	8,477	Billion Btu
as % of overall projected sales in that year	1.42%	19.12%	
Incremental GHG Emission Savings, Fuel Oil/LPG	**0.0**	**0.6**	$MMtCO_2e$

Note that emission factor used here covers all RCI petroleum use, not just those uses of petroleum (and LPG) included in RCI-1, and as such may slightly (by a percent or two) under-count emissions savings, since the average industrial-sector emission factor is probably somewhat less than an emission factor for industrial distillate and LPG use only.

Economic Analysis

Additional Investments to Meet RCI-1 Savings Targets			
--Natural Gas Utility Programs			
Net Present Value (2008-2020)		**-$377**	$million
Cumulative Emissions Reductions (2008-2020)		**12.3**	$MMtCO_2e$
Cost-Effectiveness		**-$31**	$\$/tCO_2e$
--Fuel Oil/LPG Programs			
Net Present Value (2008-2020)		**-$121**	$million
Cumulative Emissions Reductions (2008-2020)		**3.3**	$MMtCO_2e$
Cost-Effectiveness		**-$37**	$\$/tCO_2e$
--Total of Electric and Gas Programs			
Incremental GHG Emission Savings, Natural Gas and Oil/LPG	**0.6**	**2.8**	$MMtCO_2e$
Net Present Value (2008-2020)		**-$498**	$million
Cumulative Emissions Reductions (2008-2020)		**15.6**	$MMtCO_2e$
Cost-Effectiveness		**-$32**	$\$/tCO_2e$



Notes and Sources

Note 1:

A compilation of information on investment by WA natural gas utilities in energy efficiency programs as of about 2002-2003 (http://www.raponline.org/Pubs/RatePayerFundedEE/RatePayerFundedWA.pdf) indicated investment of about $ 2,100,000 by Avista, Northwest Natural Gas, and Cacade Natural Gas. Puget Sound Energy (PSE) reports investment of $6,490,000 in gas efficiency programs as of 2006 (PSE, personal communication). Assuming that these level of investment are roughly sustained implies a statewide investment of approximately 0.40% of gas utility revenue as of 2007, though these figures could increase in based on as-yet unfiled plans for the next few years.

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

RCI-3 **Promotion and Incentives for Improved Community Planning and Improved Design and Construction (Third-party Sustainability, Green, and Energy Efficiency Building Certification Programs) in the Private and Non-State Public Sectors**

Date Last Modified: *11/9/2007 D. Von Hippel*

Key Data and Assumptions	2012	2020/all	Units
First Year Results Accrue *Placeholder assumption pending TWG input*		**2009**	
Electricity	**2012**	**2020/all**	**Units**
Levelized Cost of Electricity Savings *Preliminary estimate based on 7-year payback as estimated in WGA CDEAC EE Report. See Note 1.*		**$31**	$/MWh
Levelized Cost of Natural Gas Savings *Preliminary estimate based on 7-year payback as estimated in WGA CDEAC EE Report. See Note 1.*		**$5.4**	$/MMBtu
Avoided Electricity Cost *See "Common Factors" worksheet in this workbook.*		**$64**	$/MWh
Avoided Natural Gas Cost *See "NG prices aeo2006" and "Common Factors" worksheets in this workbook.*		**$6.8**	$/MMBtu

Other Data, Assumptions, Calculations	2012	2020/all	Units
Inputs to/Intermediate Results of Calculation of Electricity and Gas Savings			
Average Electricity and Gas Savings for new commercial and residential buildings in Improved Design and Construction Element of Program *The description for this option currently includes the following: "Consider going beyond existing certification programs to Architecture 2030-level goals for new buildings, providing energy consumption performance (energy intensity) that is 50% of the regional average for each building type...". This is interpreted to mean that participating buildings throughout the implementation of this option will be on average 50 percent more efficient than the average buldings currently in place in Washington.* ***Note in particular that the level of savings shown here is beyond that already included in building code improvements assumed to be a part of "existing actions", and thus already includes an improvement in efficiency relative to average current practice.***	**50%**	**50%**	
Total Commercial Floorspace in Washington (million square feet) *Estimated (see "WA_Activities_Est" worksheet in this workbook) based on USDOE EIA CBECS (comercial survey) data for the Pacific region, extrapolated using projected Washington population as a driver.*	**1,812**	**2,049**	
Est. area of new commercial space per year in WA (million square feet) *Calculated based on annual floorspace estimates above.*	**23.5**	**23.4**	
Total Residential Housing Units in Washington *Assumes 2005 ratio of new homes to increase in population holds through 2020. Based on 2005 WA housing units as provided in U.S Census Bureau annual data, http://www.census.gov/popest/housing/HU-EST2005.html.*	**2,824,354**	**3,193,580**	
Implied persons per housing units in Washington (for reference only)	**2.35**	**2.35**	
Estimated number of new residential units per year *Calculated based on estimates above.*	**36,550**	**36,427**	
Implied Average Electricity Consumption per Square Foot Commercial Space in Washington as of 2005 (see Note 2)		16.51	kWh/yr
Implied Average Natural Gas Consumption per Square Foot Commercial Space in Washington as of 2005 (see Note 2)		26.73	kBtu/yr
Implied Average Electricity Consumption per Housing Unit in Washington as of 2005 (see Note 2)		**12.53**	MWh/yr
Implied Average Natural Gas Consumption per Housing Unit in Washington as of 2005 (see Note 2)		**28.60**	MMBtu/yr

CALCULATION OF ENERGY USE IN NEW BUILDINGS BEFORE RCI-3 APPLICATION

Estimated average first-year electricity savings from recent changes to building codes in Washington, as of 2007 *From estimate of building code improvements in WA (2002, 2005, and 2007) included in estimate of GHG emissions reduction from "recent actions" in Washington as of August, 2007. Original source, Klump, Liz (CTED, 2006), Building Energy Code Update.*	11.80	GWh/yr
Estimated average first-year natural gas savings from recent changes to building codes in Washington, as of 2007 *From estimate of building code improvements in WA (2002, 2005, and 2007) included in estimate of GHG emissions reduction from "recent actions" in Washington as of August, 2007. Original source, Klump, Liz (CTED, 2006), Building Energy Code Update.*	140,000	MMBtu/yr

	2012	2020/all	Units
Implied fractional savings in electricity use from code changes above relative to average building electricity consumption in Washington in 2005.	**1.4%**	**1.4%**	
Implied fractional savings in natural gas use from code changes above relative to average building electricity consumption in Washington in 2005.	**8.3%**	**8.4%**	
Estimated reduction of electricity use in new residential buildings in 2005, BEFORE applications of code changes, relative to average use of electricity in residential buildings in Washington in 2005: *Placeholder estimate.*		10%	
Estimated reduction of electricity use in new commercial buildings in 2005, BEFORE applications of code changes, relative to average use of electricity in commercial buildings in Washington in 2005: *Placeholder estimate.*		10%	
Estimated reduction of natural gas use in new residential buildings in 2005, BEFORE applications of code changes, relative to average use of natural gas in residential buildings in Washington in 2005: *Placeholder estimate.*		10%	
Estimated reduction of natual gas use in new commercial buildings in 2005, BEFORE applications of code changes, relative to average use of natural gas in commercial buildings in Washington in 2005: *Placeholder estimate.*		10%	
Electricity Use per New/Renovated Commercial Sq. Ft. After Building Codes Improvements Application *Reduces future per-unit electricity use based on savings from building code improvements and assumed new-versus-existing-space electricity use, as noted above.*	**14.6**	**14.6**	kWh/yr
Natural Gas Use per New/Renovated Commercial Sq. Ft. After Building Codes Improvements Application *Reduces future per-unit natural gas use based on savings from building code improvements and assumed new-versus-existing-space natural gas use, as noted above.*	**21.8**	**21.8**	kBtu/yr
Implied Electricity Use per New/Renovated Commercial Square Foot After Building Code Improvement Application, Relative to Average in Washington as of 2005	**88.6%**	**88.6%**	
Implied Natural Gas Use per New/Renovated Commercial Square Foot After Building Code Improvement Application, Relative to Average in Washington as of 2005	**81.6%**	**81.6%**	
Electricity Use per New/Renovated Residential Unit After Building Codes Improvements Application *Reduces future per-unit electricity use based on savings from building code improvements and assumed new-versus-existing-space electricity use, as noted above.*	**11.1**	**11.1**	MWh/yr
Natural Gas Use per New/Renovated Residential Unit After Building Codes Improvements Application *Reduces future per-unit natural gas use based on savings from building code improvements and assumed new-versus-existing-space natural gas use, as noted above.*	**23.3**	**23.3**	kBtu/yr
Implied Electricity Use per New/Renovated Residential Units After Existing Actions Building Codea Application, Relative to Average in Washington as of 2005	**88.6%**	**88.6%**	
Implied Natural Gas Use per New/Renovated Residential Unist After	**81.6%**	**81.6%**	

PROGRAM ASSUMPTIONS FOR RCI-3	2012	2020/all	Units
Date program of improvement of new buildings fully "ramped up" *Placeholder estimate pending TWG review.*		2012	
Assumptions for Improved Design and Construction Element of Option			
Fraction of new commercial buildings participating in program at full program level *Placeholder estimate pending TWG review.*		50%	/yr
Fraction of new residential buildings participating in program at full program level *Placeholder estimate pending TWG review.*		50%	/yr
Implied fraction of new commercial floorspace included in program *Note that state government-sector floorspace is covered under existing actions*	**50.0%**	**50.0%**	/yr
Implied commercial floorspace included in program (million square feet)	**11.836**	**11.687**	/yr
Implied fraction of new residential units included in program	**50.0%**	**50.0%**	/yr
Implied new residential units included in program	**18,445**	**18,213**	/yr
Assumptions for Improved Community Planning Element of Option			
Fraction of new commercial floorspace included in Community Planning Element *Placeholder estimate pending TWG review. Considered in addtion to buildings included in Improved Design and Construction Element of this option.*		20%	
Fraction of new residential floorspace included in Community Planning Element *Placeholder estimate pending TWG review. Considered in addtion to buildings included in Improved Design and Construction Element of this option.*		20%	
Date by which upgrading goal for community planning element achieved *Placeholder estimate pending TWG review.*		2020	
Date by which upgrading goal for community planning element fully "ramped up" *Assumed same as for new buildings.*		2014	
"Ramp-in" Multiplier for Community Planning Element:	**66.7%**	**100.0%**	
Additional Electricity and Gas savings from inclusion of new commercial buildings in community planning element *Fractional savings beyond savings included in improved design and construction element of option, relative to average 2005 building energy use in Washington. Placeholder estimate pending TWG review.*		10%	
Additional Electricity and Gas savings from inclusion of new residential buildings in community planning element *Fractional savings beyond savings included in improved design and construction element of option, relative to average 2005 building energy use in Washington. Placeholder estimate pending TWG review.*		10%	

ADDITIONAL ASSSUMPTIONS AND CALCULATION OF ANNUAL SAVINGS--DESIGN AND CONSTRUCTION ELEMENT

	2012	2020/all	Units
Required Elect/Gas Improvement in New Commercial and Residential Space After Design and Construction Element Relative to 2005 average buildings. *Calculated based on inputs above.*	50.0%	50.0%	
Implied total electricity savings in new commercial buildings from Design and Construction Element *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*	75.48	74.50	GWh/yr
Implied total gas savings in new commercial buildings from Design and Construction Element *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*	100.30	98.71	GBtu/yr
Implied total electricity savings in new residential buildings from Design and Construction Element *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*	89.22	88.05	GWh/yr
Implied total gas savings in new residential buildings from Design and Construction Element *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*	167.25	164.60	GBtu/yr

For Design and Construction Element:

Average Fraction of Improvement in Residential and Commercial Electric Energy Intensities from:

	2012	2020/all
Energy Efficiency Improvement	83%	80%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	7%
On-site Solar PV	1%	2%
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	1%
Green Power Purchase (from off-site, beyond electricity supply RPS)	10%	10%

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

Average Fraction of Improvement in Residential and Commercial Gas Energy Intensities from:

	2012	2020/all
Energy Efficiency Improvement	94%	91%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	7%
On-site Solar PV	0%	0%
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	2%
Green Power Purchase (from off-site, beyond electricity supply RPS)	0%	0%

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

	2012	2020/all
Adjustment for Inclusion of Rennovated Commercial Space as Well as New Under Program. *Currently set at 1.5 so that about 0.5 unit of renovated space is included per unit of new space (initial assumption). See Note 3. It may be useful to get further WA-specfic information regarding this value.*		1.50
Adjustment of Energy Use per Unit Floor Area for Commercial Buildings in Program Relative to Average Commercial Building in Washington *Placeholder assumption.*	1.00	1.00
Adjustment for Inclusion of Rennovated Residential Units as Well as New Under Program. *Currently set at 1.0 so that no renovated space is included per unit of new space (initial assumption). It may be useful to obtain further WA-specfic information regarding this value.*		1.00

ADDITIONAL ASSSUMPTIONS AND CALCULATION OF ANNUAL SAVINGS--COMMUNITY PLANNING ELEMENT

	2012	2020/all	Units
Required Elect/Gas Improvement in New Commercial Space	60.0%	60.0%	
Required Elect/Gas Improvement in New Residential Space	60.0%	60.0%	
Implied total electricity savings in new commercial buildings from Community Planning Element	38.01	37.52	GWh/yr
Implied total gas savings in new commercial buildings from Community Planning Element	52.78	51.98	GBtu/yr
Implied total electricity savings in new residential buildings from Community Planning Element	44.93	44.35	GWh/yr
Implied total gas savings in new residential buildings from Community Planning Element	88.00	86.67	GBtu/yr

Required Elect/Gas Improvement in New Commercial Space: After Community Planning and Design and Construction Elements, Relative to 2005 average buildings.
Calculated based on inputs above.

Required Elect/Gas Improvement in New Residential Space: After Community Planning and Design and Construction Elements, Relative to 2005 average buildings.
Calculated based on inputs above.

Implied total electricity savings in new commercial buildings: *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*

Implied total gas savings in new commercial buildings: *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*

Implied total electricity savings in new residential buildings: *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*

Implied total gas savings in new residential buildings: *First-year savings--not cumulative. Savings do NOT include savings from code changes included in existing actions.*

For Community Design Element:

Average Fraction of Improvement in Residential and Commercial Electric Energy Intensities from:

	2012	2020/all
Energy Efficiency Improvement	83%	72%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	12%
On-site Solar PV	1%	3%
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	3%
Green Power Purchase (from off-site, beyond electricity supply RPS)	10%	10%

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to

Average Fraction of Improvement in Residential and Commercial Gas Energy Intensities from:

	2012	2020/all
Energy Efficiency Improvement	94%	85%
Solar Thermal Energy (hot water/space heat/space cooling)	5%	12%
On-site Solar PV	0%	0%
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	3%
Green Power Purchase (from off-site, beyond electricity supply RPS)	0%	0%

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to

Intermediate Results of Energy Savings Analyses

For Design and Construction Element:

Implied Cumulative Impacts of Option, New Commercial Space (Electricity savings)

Energy Efficiency Improvement	233.1	970.9	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	14.0	69.6	GWh
On-site Solar PV	2.8	17.0	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	2.8	11.9	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	28.1	118.8	GWh

Implied Cumulative Impacts of Option, New Commercial Space (Natural Gas savings)

Energy Efficiency Improvement	350.2	1,463.8	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	18.6	92.5	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	3.7	22.5	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Implied Cumulative Impacts of Option, New Residential Space (Electricity savings)

Energy Efficiency Improvement	183.7	765.1	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	11.1	54.8	GWh
On-site Solar PV	2.2	13.4	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	2.2	9.4	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	22.1	93.6	GWh

Implied Cumulative Impacts of Option, New Residential Space (Natural Gas savings)

Energy Efficiency Improvement	389.2	1,627.2	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	20.7	102.8	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	4.1	25.1	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

For Community Planning Element:

Implied Cumulative Impacts of Community Planning Element, Commercial Space (Electricity savings)

Energy Efficiency Improvement	117.4	468.5	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	7.1	47.9	GWh
On-site Solar PV	1.4	11.1	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	1.4	11.1	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	14.1	59.8	GWh

Implied Cumulative Impacts of Community Planning Element, Commercial Space (gas savings)

Energy Efficiency Improvement	184.3	748.9	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	9.8	66.4	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	2.0	15.4	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Implied Cumulative Impacts of Community Planning Element, Residential Space (Electricity savings)

Energy Efficiency Improvement	92.5	369.1	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	5.6	37.7	GWh
On-site Solar PV	1.1	8.8	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	1.1	8.8	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	11.1	47.1	GWh

Implied Cumulative Impacts of Community Planning Element, Residential Space (gas savings)

Energy Efficiency Improvement	204.9	832.5	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	10.9	73.9	GBtu/yr
On-site Solar PV	-	-	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	2.2	17.1	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	GBtu/yr

Additional Inputs to/Intermediate Results of Costs Analyses

	2012	2020/all	Units
Incremental Capital Cost of Solar Water Heater (relative to electric or gas unit)	**$5,000**	**$4,000**	
Assumption for residential unit, and assumes costs will decrease over time. Due to high prices for metals, current retail costs of solar hot water systems are higher than 2012 value shown.			
Fraction of household hot water needs provided by solar HW units	**65.0%**	**70.0%**	
Rough Estimate, but consistent with rule of thumb from Puget Sound Solar Inc (http://www.pugetsoundsolar.com/starthere.html) for Seattle area installation.			
Average annual water heating energy used per household (hot water output)		12.69	MMBtu
Based on assumption of household with electric water heater using 4000 kWh/yr at average efficiency (EF) of 93% heat in hot water/electrical energy input.			
Inputs to Cost Estimates for Residential Solar PV Systems (Data from Source in Note 4)			
Average Capacity of Solar PV System Installed on New Homes (kW)	**2.00**	**2.00**	
Assumption, consistent with capacity assumption used in Source in ***Note 4*** *.*			
Capital Costs for PV Systems for New Homes			
Module	**$ 3,019**	**$ 2,003**	
BOS (Balance of System)	**$ 1,115**	**$ 739**	
Installation	**$ 331**	**$ 143**	
Total System - $/kW	**$ 4,465**	**$ 2,885**	
Total System - $	**$ 8,929**	**$ 5,769**	
Average full-capacity-equivalent hours of operation for Solar PV Systems:	**1,200**	**1,200**	
Rough estimate, but consistent, for example, with rule-of-thumb from Puget Sound Solar, Inc. (http://www.pugetsoundsolar.com/starthere.html) for Seattle area installation.			
Factors for Annualizing Capital Costs (Residential PV and Solar Hot Water Systems)			
Interest Rate (real)		7%	/yr
Economic Life of System		20	years
Implied Annualization Factor		9.44%	%/yr
Marginal Federal Tax Rate, Residential		28%	
Federal Solar Tax Credits: Residential Sector--See ***Note 5***	0%	0%	
Capital Cost per Unit Capacity (and output) of Commercial Versus Residential Solar HW Heaters		**70%**	
Placeholder Assumption. Assumes economies of scale for materials and installation for commercial units relative to (significantly smaller, on average) residential units.			
Commercial System Capital costs/kW Relative to New Residential	80%	80%	
Rough assumption, but similar to values in literature--See ***Note 6*** *.*			
Federal Solar Tax Credits: Commercial Sector--See ***Note 5.***	10%	10%	
Other Factors for Annualizing Capital Costs (Commercial PV and Solar Hot Water Systems)			
Interest Rate (real)		8%	/yr
Economic Life of System		20	years
Implied Annualization Factor		10.19%	%/yr
Estimated annual levelized cost of residential solar hot water per unit output	**41.19**	**30.60**	$/MMBtu
Calculated based on inputs above.			
Estimated annual levelized cost of commercial solar hot water per unit output	**38.89**	**28.89**	$/MMBtu
Calculated based on inputs above.			
Adjustment to solar thermal costs for inclusion of space heat/cooling measures	1.00	1.00	
Placeholder assumption--Value of 1.0 implies that solar space heat and cooling will cost the same per unit output as solar water heating.			

Implied Per Unit Cost Electricity Avoided by Solar WH/SH/Cooling (Residential)	130.70	97.09	$/MWh
Implied Per Unit Cost Natural Gas Avoided by Solar WH/SH/Cooling (Residential)	28.83	21.42	$/MMBtu

Assumes delivered solar WH/SH/Cooling replaces electric with EF of 0.93, gas with EF of 0.70 (and therefore one MMBtu of delivered solar heat is the equivalent of more than one MMBtu of each fuel).

Implied Per Unit Cost Electricity Avoided by Solar WH/SH/Cooling (Commercial)	123.40	91.67	$/MWh
Implied Per Unit Cost Natural Gas Avoided by Solar WH/SH/Cooling (Commecial)	27.22	20.22	$/MMBtu

Assumes delivered solar WH/SH/Cooling replaces electric with EF of 0.93, gas with EF of 0.70 (and therefore one MMBtu of delivered solar heat is the equivalent of more than one MMBtu of each fuel).

Estimated annual levelized cost of on-site Solar PV, Residential	565	327	$/MWh

Calculated based on inputs above.

Estimated annual levelized cost of on-site Solar PV, Commercial	610	353	$/MWh

Calculated based on inputs above.

Fuel Cost for On-site Biomass/Biogas/Landfill Gas Energy Use	3.31	$/MMBtu

Based on costs for Biomass fuel, which will likely dominate this category of fuel inputs. See "Common Factors" worksheet in this workbook. If significantly processed biomass fuels (such as pelletized fuels) are required, this cost may need to be increased.

Relative Efficiency of On-site Biomass/Biogas/Landfill Gas displacing electricity	0.75

Placeholder assumption.

Factor to reflect probable higher costs of on-site Biomass/Biogas/Landfill Gas Equipment Relative to Electric Equipment	1.50

Placeholder assumption--In most cases, heating/water heating equipment designed to use biomass-derived fuels will be more expensive than equipment designed to use electricity. This factor loads these incremental capital costs into estimated fuel costs.

Implied Per Unit Cost Electricity Avoided by Biomass/Biogas/Landfill Gas	22.48	22.48	$/MWh
Incremental Cost for Green Power Purchase (from off-site, beyond supply RPS)	25.00	20.00	$/MWh

Placeholder assumption, but should be linked to assumptions for relevant ES options, if necessary.

Implied Annual Net Costs of Option, New Commercial Space (Electricity savings)			
Energy Efficiency Improvement	$ (7,639)	$ (31,822)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 831	$ 2,921	$ thousand
On-site Solar PV	$ 1,441	$ 6,484	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (54)	$ (230)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 702	$ 2,716	$ thousand
Implied Annual Net Costs of Option, New Commercial Space (Natural Gas savings)			
Energy Efficiency Improvement	$ (487)	$ (2,037)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 381	$ 1,538	$ thousand
On-site Solar PV	$ -	$ -	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (13)	$ (79)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ -	$ -	$ thousand
Implied Annual Net Costs of Option, New Residential Space (Electricity savings)			
Energy Efficiency Improvement	$ (6,019)	$ (25,075)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 736	$ 2,646	$ thousand
On-site Solar PV	$ 1,042	$ 4,672	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (43)	$ (182)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 553	$ 2,140	$ thousand
Implied Annual Net Costs of Option, New Residential Space (Natural Gas savings)			
Energy Efficiency Improvement	$ (542)	$ (2,265)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 456	$ 1,852	$ thousand
On-site Solar PV	$ -	$ -	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (14)	$ (87)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ -	$ -	$ thousand

For Community Planning Element:

Implied Annual Net Costs of Community Planning Element, Commercial Space (Electricity savings)

Energy Efficiency Improvement	$ (3,847)	$ (15,353)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 419	$ 1,909	$ thousand
On-site Solar PV	$ 726	$ 4,133	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (27)	$ (215)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 354	$ 1,368	$ thousand

Implied Annual Net Costs of Community Planning Element, Commercial Space (gas savings)

Energy Efficiency Improvement	$ (257)	$ (1,042)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 200	$ 1,074	$ thousand
On-site Solar PV	$ -	$ -	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (7)	$ (54)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ -	$ -	$ thousand

Implied Annual Net Costs of Community Planning Element, Residential Space (Electricity savings)

Energy Efficiency Improvement	$ (3,031)	$ (12,098)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 371	$ 1,736	$ thousand
On-site Solar PV	$ 525	$ 2,977	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (22)	$ (170)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 279	$ 1,078	$ thousand

Implied Annual Net Costs of Community Planning Element, Residential Space (gas savings)

Energy Efficiency Improvement	(285.2)	(1,158.5)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	240.2	1,294.4	$ thousand
On-site Solar PV	-	-	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	(7.6)	(59.8)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	-	-	$ thousand

Results	2012	2020	Units
Electricity (Conventional)			
Reduction in Electricity Sales: Residential	333	1,408	GWh (sales)
Reduction in Electricity Sales: Commercial	422	1,787	GWh (sales)
TOTAL Reduction in Electricity Sales	755	3,194	GWh (sales)
Reduction in Generation Requirements	814	3,436	GWh (generation)
GHG Emission Savings	**0.41**	**1.72**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$189**	$million
Cumulative Emissions Reductions (2008-2020)		10.0	$MMtCO_2e$
Cost-Effectiveness		**-$18.89**	$\$/tCO_2e$
Natural Gas			
Reduction in Gas Use, Residential Sector	632	2,678	Billion BTU
Reduction in Gas Use, Commercial Sector	569	2,409	Billion BTU
TOTAL Reduction in Gas Sales	1,201	5,088	Billion BTU
GHG Emission Savings	**0.06**	**0.27**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$4**	$million
Cumulative Emissions Reductions (2008-2020)		1.56	$MMtCO_2e$
Cost-Effectiveness		**-$2.80**	$\$/tCO_2e$
Biomass/Biogas/Landfill Gas Fuel Use			
Added GHG Emissions from Biomass Fuels Use	**0.00012**	**0.00067**	$MMtCO_2e$
Cumulative added Emissions from Biomass Fuels (2008-2020)		0.0034	$MMtCO_2e$

Summary Results for RCI-3	2012	2020	Units
Total for Option (Natural gas and Electricity less Biomass)			
GHG Emission Savings	**0.47**	**1.99**	$MMtCO_2e$
Net Present Value (2008-2020)		**-$192.9**	$million
Cumulative Emissions Reductions (2008-2020)		11.5	$MMtCO_2e$
Cost-Effectiveness		**-$16.71**	$/t$CO_2e$

Additional Summary Results for RCI-3 for Reporting	2010	2020	Units
Total Green Power Purchased Under RCI-3	75	319	GWh (sales)
Total Green Power Generation to Serve RCI-3	82	345	GWh (generation)
GHG Emission Savings from Green Power Component	**0.04**	**0.17**	$MMtCO_2e$
Net Present Value (2008-2020) of Green Power component of RCI-3		**$25.8**	$million
Total Renewable Electricity Under RCI-3	8	50	GWh (at consumer site)
Total Reduction in Conventional Generation due to Renewable Electricity Under RCI-3	8	54	GWh (equivalent at central generator)
Net Present Value (2008-2020) of renewable electricity component of RCI-3	**0.00**	**0.03**	$MMtCO_2e$
		$49.9	$million

NOTES AND DATA FROM SOURCES

Note 1:

From The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association.
The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at: http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.
The CDEAC report provides a cost of saved energy (electricity) based on an average 7-year payback for code improvements (page 42). This is likely to be a lower bound for the cost of green building practices that yield a 50 percent improvement over existing buildings, but is used as a starting point for this analysis.

For Washington, the equivalent cost is estimated as follows for electricity and natural gas

payback	7	years, from CDEAC report
lifespan	25	years, conservative assumption
elec price	**$63**	$/MWh (weighted average levelized cost of residential and commercial electricity prices in WA--See Common Factors worksheet).
NG price	**$10.87**	$/MMBtu (weighted average levelized cost of residential and commercial natural gas prices in WA--See Common Factors worksheet).

Electricity levelized cost	$31.425	$/MWh
Natural Gas levelized cost	$5.401	$/MMBTU

Note 2:
Based on results from Table B.5 of the 2003 Commercial Buildings Energy Consumption Survey, Detailed Tables dated October 2006 and published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf, as described in "WA_Activities_Est" worksheet in this workbook.

Following data on electricity sales in Washington as of 2005 as described in "Utility_Sales" worksheet in this workbook.
Downloaded from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)

	MWh	Fraction of Total
Residential	33,212,197	40%
Commercial	28,099,583	34%
Industrial	22,111,773	27%
Total	83,423,553	100%

For natural gas use in Washington, consumption data are from the USDOE EIA downloaded from http://www.eia.doe.gov/oil_gas/natural_gas/applications/eia176query.html are are follows:
(See "EIA_NG_Data" worksheet in this workbook for raw EIA data)

	Sales (Million Cubic Feet of Natural Gas)			
	Residential	Commercial	Industrial	Total
2005	73,626	44,155	10,565	128,347
Fraction of 2005 Total	57%	34%	8%	100%

Note 3:
The estimate of 0.5 unit of renovated space per unit of new construction in the commercial sector is a rough assumption.
It is likely that the ratio of commercial space undergoing major renovation to new commerial space will fluctuate year by year, and it may be necessary to get a more specific figure for this parameter. It is clear, however, that the renovation market represents a substantial opportunity for improving energy efficiency through code changes. A study of the non-residential renovation market in California (Remodeling and Renovation of Nonresidential Buildings in California, by Donald R. Dohrmann, John H. Reed, Sylvia Bender, Catherine Chappell, and Pierre Landry, available as http://www.energy.ca.gov/papers/2002-08-18_aceee_presentations/PANEL-10_DOHRMANN.PDF) suggests that by 1999 the value of renovations and additions to non-residential space was similar to that in new non-residential space, based on building permit data. As California includes a significant fraction of older buildings in its building stocks, renovations may be a smaller fraction of building activity in Washington.

Note 4:
Source: Worksheet "Solar Homes Summary table.xls", with calculations in support of the California Million Solar Homes Initiative, authored by XENERGY, Inc., and provided by M. Lazarus. Selected annual data provided.

Note 5:
A description of the new Federal Solar Tax Credits for businesses and residences as contained in the Energy Policy Act of 2005 (EPAct 2005) (see, for example, http://www.seia.org/getpdf.php?iid=21) provides for 30% (of system cost) tax credits for solar PV investments by businesses in 2006 and 2007, reverting to 10% thereafter. For residences, the credit in 2006 and 2007 is 30% with a "cap" of $2000, reverting to zero after 2007. For the purpose of this analysis, we are modeling the federal tax credit at its long-term (10% business, 0% residential) level, as no systems are added in 2006 and 2007.
See also, for Example,
http://www.sdenergy.org/uploads/PV-Federal%20Tax%20Credits%20Summary%206-01-04%20FINAL.pdf.

Note 6:
Source: International Energy Agency (IEA), TRENDS IN PHOTOVOLTAIC APPLICATIONS Survey report of selected IEA countries between 1992 and 2004. Report #IEA-PVPS T1-14:2005.
Page 18.
"Indicative costs" in 2004 in USD per kWp (assumedly DC output) for on-grid PV systems in the US:

<10 kW	7000 to 10,000
>10 kW	6300 to 8500

In EIA Projections of Renewable Energy Costs, presented in "Forum on the Economic Impact Analysis of NJ's Proposed 20% RPS" by Chris Namovicz of the USDOE EIA (Energy Information Administration), dated February 22, 2005, and available as http://www.eia.doe.gov/oiaf/pdf/rec.pdf, a wind power average cost of

6000	dollars/kW is provided for a 25 kW Commercial system, or
8200	dollars/kW for a 2 kW Residential system, with

"Large potential for cost reduction".

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

RCI-4 **Energy Efficiency Improvement in Existing Buildings, with Emphasis on Building Operations**

Date Last Modified: *11/9/2007 D. Von Hippel*

Key Data and Assumptions	2012	2020/all	Units
First Year Results Accrue *Placeholder assumption pending TWG input*		2009	
Electricity	**2012**	**2020/all**	**Units**
Levelized Cost of Electricity Savings *Preliminary estimate based on 7-year payback as estimated in WGA CDEAC EE Report. See Note 1.*		$31	$/MWh
Levelized Cost of Natural Gas Savings *Preliminary estimate based on 7-year payback as estimated in WGA CDEAC EE Report. See Note 1.*		$5.4	$/MMBtu
Avoided Electricity Cost *See "Common Factors" worksheet in this workbook.*		$64	$/MWh
Avoided Natural Gas Cost *See "NG prices aeo2006" and "Common Factors" worksheets in this workbook.*		$6.8	$/MMBtu

Other Data, Assumptions, Calculations	2012	2020/all	Units
Inputs to/Intermediate Results of Calculation of Electricity and Gas Savings			
Average Electricity and Gas Savings for Buildings Participating in Program (existing commercial and residential buildings) *The description for this option currently includes the following: "Reduce energy use in the existing residential, commercial and industrial building stock by an average of 50%". This is interpreted to mean a 50 percent reduction in the use of conventional grid-based electricity, natural gas, and other fossil fuels (though only natural gas and electricity are included in this analysis).*	20%	20%	
Total Commercial Floorspace in Washington (million square feet) *Estimated (see "WA_Activities_Est" worksheet in this workbook) based on USDOE EIA CBECS (comercial survey) data for the Pacific region, extrapolated using projected Washington population as a driver.*	1,860	2,049	
Est. area of new commercial space per year in WA (million square feet) *Calculated based on annual floorspace estimates above.*	23.7	23.4	
Total Residential Housing Units in Washington *Assumes 2005 ratio of new homes to increase in population holds through 2020. Based on 2005 WA housing units as provided in U.S Census Bureau annual data, http://www.census.gov/popest/housing/HU-EST2005.html.*	2,897,949	3,193,580	
Implied persons per housing units in Washington (for reference only)	2.35	2.35	
Estimated number of new residential units per year *Calculated based on estimates above.*	36,890	36,427	
Implied Average Electricity Consumption per Square Foot Commercial Space in Washington as of 2005 (see ***Note 2***)		16.51	kWh/yr
Implied Average Natural Gas Consumption per Square Foot Commercial Space in Washington as of 2005 (see ***Note 2***)		26.73	kBtu/yr
Implied Average Electricity Consumption per Housing Unit in Washington as of 2005 (see ***Note 2***)		12.53	MWh/yr
Implied Average Natural Gas Consumption per Housing Unit in Washington as of 2005 (see ***Note 2***)		28.60	MMBtu/yr

PROGRAM ASSUMPTIONS FOR RCI-4	**2012**	**2020/all**	**Units**
Date program of improvement of existing buildings fully "ramped up" *Placeholder estimate pending TWG review.*		2012	
Date by which program goals met *Program Goal.*		2020	
Fraction of existing (as of 2005) commercial buildings participating in program through target date *Program Goal.*		50%	/yr
Fraction of existing (as of 2005) Residential buildings participating in program through target *Program Goal.*		50%	
Fraction of existing (as of 2005) Commercial Floorspaceparticipating in program annually after ramp-in *Determined iteratively based on participating fraction, ramp-in date, and goal target date.*		4.762%	/yr
Value currently IS OK — Check figure:	50.00%		
Implied fraction of existing commercial floorspace included in program annually. *Calculated from above.*	**4.8%**	**4.8%**	/yr
Implied existing commercial floorspace included in program (million square feet)	**81.024**	**81.024**	/yr
Fraction of existing (as of 2005) Residential Units participating in program annually after ramp-in *Determined iteratively based on participating fraction, ramp-in date, and goal target date.*		4.762%	/yr
Value currently IS OK — Check figure:	50.0000%		
Implied fraction of new residential units included in program *Calculated from above.*	**4.8%**	**4.8%**	/yr
Implied existing residential units included in program	**63,134**	**126,269**	/yr
Factor to include non-process Industrial electricity use in analysis		**14.3%**	
Factor to include non-process Industrial natural gas use in analysis		**1.6%**	

Fractions of total Commercial-sector electricity and gas use. iApplied to account for efficiency and other improvements in industrial buildings. See ***Note 3*** *.*

CALCULATION OF SAVINGS

	2012	**2020/all**	**Units**
Required Elect/Gas Improvement in Existing Commercial and Residential Space After RCI-4 Policy Relative to Average in After Application of RCI-4 *Calculated based on inputs above.*	**20.0%**	**20.0%**	
Implied total electricity savings in existing commercial buildings from RCI-4 *First-year savings--not cumulative.*	**268**	**268**	GWh/yr
Implied total gas savings in existing commercial buildings from RCI-4. *First-year savings--not cumulative.*	**217**	**433**	GBtu/yr
Implied total electricity savings in existing residential buildings from RCI-4 *First-year savings--not cumulative.*	**158**	**316**	GWh/yr
Implied total gas savings in existing residential buildings from RCI-4 *First-year savings--not cumulative.*	**361**	**722**	GBtu/yr

	2012	2020/all	Units
Average Fraction of Improvement in Electric Energy Intensities from:			
Energy Efficiency Improvement	90%	85%	
Solar Thermal Energy (hot water/space heat/space cooling)	3%	5%	
On-site Solar PV	1%	2%	
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	3%	
Green Power Purchase (from off-site, beyond electricity supply RPS)	5%	5%	

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

	2012	2020/all	Units
Average Fraction of Improvement in Gas Energy Intensities from:			
Energy Efficiency Improvement	96%	92%	
Solar Thermal Energy (hot water/space heat/space cooling)	3%	5%	
On-site Solar PV	0%	0%	
On-site Biomass/Biogas/Landfill Gas Energy Use	1%	3%	
Green Power Purchase (from off-site, beyond electricity supply RPS)	0%	0%	

All "placeholder" assumptions, except on-site biomass/biogas/landfill gas energy use calculated so that values sum to 100%.

	2012	2020/all	Units
Adjustment of Energy Use per Unit Floor Area for Commercial Buildings in Program Relative to Average Commercial Building in Washington	1.00	1.00	

Placeholder assumption.

	2012	2020/all	Units
Implied Cumulative Impacts of Option, Existing Commercial Space (Electricity savings)			
Energy Efficiency Improvement	**180.6**	**2,455.7**	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	**6.0**	**113.6**	GWh
On-site Solar PV	**2.0**	**42.8**	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	**2.0**	**57.4**	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	**10.0**	**140.5**	GWh
Implied Cumulative Impacts of Option, Existing Commercial Space (Natural Gas savings)			
Energy Efficiency Improvement	**311.9**	**4,271.2**	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	**9.7**	**183.9**	GBtu/yr
On-site Solar PV	**-**	**-**	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	**3.2**	**92.9**	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	**-**	**-**	GBtu/yr
Implied Cumulative Impacts of Option, Existing Industrial Space (Electricity savings)			
Energy Efficiency Improvement	**25.7**	**350.0**	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	**0.9**	**16.2**	GWh
On-site Solar PV	**0.3**	**6.1**	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	**0.3**	**8.2**	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	**1.4**	**20.0**	GWh
Implied Cumulative Impacts of Option, Existing Industrial Space (Natural Gas savings)			
Energy Efficiency Improvement	**5.0**	**68.0**	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	**0.2**	**2.9**	GBtu/yr
On-site Solar PV	**-**	**-**	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	**0.1**	**1.5**	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	**-**	**-**	GBtu/yr
Implied Cumulative Impacts of Option, Existing Residential Space (Electricity savings)			
Energy Efficiency Improvement	**213.5**	**2,902.5**	GWh
Solar Thermal Energy (hot water/space heat/space cooling)	**7.1**	**134.3**	GWh
On-site Solar PV	**2.4**	**50.5**	GWh
On-site Biomass/Biogas/Landfill Gas Energy Use	**2.4**	**67.8**	GWh
Green Power Purchase (from off-site, beyond electricity supply RPS)	**11.9**	**166.1**	GWh
Implied Cumulative Impacts of Option, Existing Residential Space (Natural Gas savings)			
Energy Efficiency Improvement	**520.0**	**7,122.0**	GBtu/yr
Solar Thermal Energy (hot water/space heat/space cooling)	**16.3**	**306.6**	GBtu/yr
On-site Solar PV	**-**	**-**	GBtu/yr
On-site Biomass/Biogas/Landfill Gas Energy Use	**5.4**	**154.9**	GBtu/yr
Green Power Purchase (from off-site, beyond electricity supply RPS)	**-**	**-**	GBtu/yr

Additional Inputs to/Intermediate Results of Costs Analyses

Item	2012	2020/all	Units
Estimated annual levelized cost of residential solar hot water per unit output *Based on inputs to/results of solar hot water heating analysis included in RCI-3.*	**41.19**	**30.60**	$/MMBtu
Estimated annual levelized cost of commercial solar hot water per unit output *Based on inputs to/results of solar hot water heating analysis included in RCI-3.*	**38.89**	**28.89**	$/MMBtu
Adjustment to solar thermal costs for inclusion of space heat/cooling measures *Placeholder assumption--Value of 1.0 implies that solar space heat and cooling will cost the same per unit output as solar water heating.*	1.00	1.00	
Implied Per Unit Cost Electricity Avoided by residential Solar WH/SH/Cooling	**130.70**	**97.09**	$/MWh
Implied Per Unit Cost Natural Gas Avoided by residential Solar WH/SH/Cooling *Assumes delivered solar WH/SH/Cooling replaces electric with EF of 0.93, gas with EF of 0.70 (and therefore one MMBtu of delivered solar heat is the equivalent of more than one MMBtu of each fuel).*	**28.83**	**21.42**	$/MMBtu
Implied Per Unit Cost Electricity Avoided by Solar WH/SH/Cooling (Commercial)	**123.40**	**91.67**	$/MWh
Implied Per Unit Cost Natural Gas Avoided by Solar WH/SH/Cooling (Commecial) *Assumes delivered solar WH/SH/Cooling replaces electric with EF of 0.93, gas with EF of 0.70 (and therefore one MMBtu of delivered solar heat is the equivalent of more than one MMBtu of each fuel).*	**27.22**	**20.22**	$/MMBtu
Estimated annual levelized cost of on-site Solar PV, Commercial *Based on inputs to/results of solar PV analysis included in RCI-3.*	**546**	**353**	$/MWh
Estimated annual levelized cost of on-site residential Solar PV *Based on inputs to/results of solar PV analysis included in RCI-3.*	**506**	**327**	$/MWh
Fuel Cost for On-site Biomass/Biogas/Landfill Gas Energy Use *Based on costs for Biomass fuel, which will likely dominate this category of fuel inputs. See "Common Assumptions" worksheet in this workbook. If significantly processed biomass fuels (such as pelletized fuels) are required, this cost may need to be increased.*		3.31	$/MMBtu
Relative Efficiency of On-site Biomass/Biogas/Landfill Gas displacing electricity *Placeholder assumption.*		0.75	
Factor to reflect probable higher costs of on-site Biomass/Biogas/Landfill Gas Equipment Relative to Electric Equipment *Placeholder assumption--In most cases, heating/water heating equipment designed to use biomass-derived fuels will be more expensive than equipment designed to use electricity. This factor loads these incremental capital costs into estimated fuel costs.*		1.50	
Implied Per Unit Cost Electricity Avoided by Biomass/Biogas/Landfill Gas	**22.48**	**22.48**	$/MWh
Incremental Cost for Green Power Purchase (from off-site, beyond supply RPS) *Placeholder assumption, but should be linked to assumptions for relevant ES options, if necessary.*	25.00	20.00	$/MWh

	2012	2020/all	Units
Implied Annual Net Costs of Option, Existing Commercial Space (Electricity savings)			
Energy Efficiency Improvement	$ (19,614)	$ (80,484)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 1,275	$ 4,725	$ thousand
On-site Solar PV	$ 3,796	$ 16,448	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (341)	$ (2,395)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 836	$ 3,211	$ thousand
Implied Annual Net Costs of Option, Existing Commercial Space (Natural Gas savings)			
Energy Efficiency Improvement	$ (1,440)	$ (5,944)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 712	$ 3,042	$ thousand
On-site Solar PV	$ -	$ -	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (46)	$ (324)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ -	$ -	$ thousand
Implied Annual Net Costs of Option, Existing Industrial Space (Electricity savings)			
Energy Efficiency Improvement	$ (2,796)	$ (11,471)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 182	$ 673	$ thousand
On-site Solar PV	$ 541	$ 2,344	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (49)	$ (341)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 119	$ 458	$ thousand
Implied Annual Net Costs of Option, Existing Industrial Space (Natural Gas savings)			
Energy Efficiency Improvement	$ (23)	$ (95)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 11	$ 48	$ thousand
On-site Solar PV	$ -	$ -	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (1)	$ (5)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ -	$ -	$ thousand
Implied Annual Net Costs of Option, Existing Residential Space (Electricity savings)			
Energy Efficiency Improvement	$ (23,183)	$ (95,128)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 1,693	$ 6,425	$ thousand
On-site Solar PV	$ 4,117	$ 17,779	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (402)	$ (2,831)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ 988	$ 3,796	$ thousand
Implied Annual Net Costs of Option, Existing Residential Space (Natural Gas savings)			
Energy Efficiency Improvement	$ (2,401)	$ (9,912)	$ thousand
Solar Thermal Energy (hot water/space heat/space cooling)	$ 1,281	$ 5,496	$ thousand
On-site Solar PV	$ -	$ -	$ thousand
On-site Biomass/Biogas/Landfill Gas Energy Use	$ (77)	$ (540)	$ thousand
Green Power Purchase (from off-site, beyond electricity supply RPS)	$ -	$ -	$ thousand

Results	2012	2020	Units
Electricity (Conventional)			
Reduction in Electricity Sales: Residential	791	3,321	GWh (sales)
Reduction in Electricity Sales: Commercial	669	2,810	GWh (sales)
Reduction in Electricity Sales: Industrial	95	400	GWh (sales)
TOTAL Reduction in Electricity Sales	1,555	6,532	GWh (sales)
Reduction in Generation Requirements	1,677	7,025	GWh (generation)
GHG Emission Savings	**0.84**	**3.51**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$499**	$million
Cumulative Emissions Reductions (2008-2020)		20.4	$MMtCO_2e$
Cost-Effectiveness		**-$24.42**	$\$/tCO_2e$
Natural Gas			
Reduction in Gas Use, Residential Sector	1,806	7,584	Billion BTU
Reduction in Gas Use, Commercial Sector	1,083	4,548	Billion BTU
Reduction in Gas Use, Industrial Sector	17	72	Billion BTU
TOTAL Reduction in Gas Sales	2,906	12,204	Billion BTU
GHG Emission Savings	**0.15**	**0.65**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$30**	$million
Cumulative Emissions Reductions (2008-2020)		3.8	$MMtCO_2e$
Cost-Effectiveness		**-$8.00**	$\$/tCO_2e$
Biomass/Biogas/Landfill Gas Fuel Use			
Added GHG Emissions from Biomass Fuels Use	**0.00029**	**0.00204**	$MMtCO_2e$
Cumulative added Emissions from Biomass Fuels (2007-2020)		0.0099	$MMtCO_2e$

Summary Results for RCI-4	2012	2020	Units
Total for Option (Natural gas and Electricity less Biomass)			
GHG Emission Savings	**0.99**	**4.16**	$MMtCO_2e$
Net Present Value (2008-2020)		**-$528.5**	$million
Cumulative Emissions Reductions (2008-2020)		24.2	$MMtCO_2e$
Cost-Effectiveness		**-$21.88**	$\$/tCO_2e$

Additional Summary Results for RCI-4 for Reporting	2012	2020	Units
Total Green Power Purchased Under RCI-4	78	327	GWh (sales)
Total Green Power Generation to Serve RCI-4	84	353	GWh (generation)
GHG Emission Savings from Green Power Component	**0.04**	**0.18**	$MMtCO_2e$
Net Present Value (2008-2020) of Green Power component of RCI-4		**$26**	$million
Total Renewable Electricity Under RCI-4	17	99	GWh (at consumer site
Total Reduction in Conventional Generation due to Renewable Electricity Under RCI-4 (displacement from Solar PV)	19	107	GWh (equivalent at central generator)
Net Present Value (2008-2020) of renewable electricity component of RCI-4	**0.01**	**0.05**	$MMtCO_2e$
		$124	$million

NOTES AND DATA FROM SOURCES

Note 1:

From The Energy Efficiency Task Force Report to the Clean and Diversified Energy Advisory Committee of the Western Governors Association.
The Potential for More Efficient Electricity Use in the Western United States, January, 2006. This report is referred to here as the "WGA CDEAC EE report" and can be found at:
http://www.westgov.org/wga/initiatives/cdeac/Energy%20Efficiency-full.pdf.
The CDEAC report provides a cost of saved energy (electricity) based on an average 7-year payback for code improvements (page 42). This is likely to be a lower bound for the cost of green building practices that yield a 50 percent improvement over existing buildings, but is used as a starting point for this analysis.

For Washington, the equivalent cost is estimated as follows for electricity and natural gas

payback	7	years, from CDEAC report
lifespan	25	years, conservative assumption
elec price	**$63**	$/MWh (weighted average levelized cost of residential and commercial electricity prices in WA--See Common Factors worksheet).
NG price	**$10.87**	$/MMBtu (weighted average levelized cost of residential and commercial natural gas prices in WA--See Common Factors worksheet).

Electricity levelized cost	$31.425	$/MWh
Natural Gas levelized cost	$5.401	$/MMBTU

Note 2:

Based on results from Table B.5 of the 2003 Commercial Buildings Energy Consumption Survey, Detailed Tables dated October 2006 and published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/cbecs/cbecs2003/detailed_tables_2003/pdf2003/alltables.pdf, as described in "WA_Activities_Est" worksheet in this workbook.

Following data on electricity sales in Washington as of 2005 as described in "Utility_Sales" worksheet in this workbook.
Downloaded from http://www.eia.doe.gov/cneaf/electricity/epa/epa_sprdshts.html (file sales_revenue.xls)

	MWh	Fraction of Total
Residential	33,212,197	40%
Commercial	28,099,583	34%
Industrial	22,111,773	27%
Total	83,423,553	100%

For natural gas use in Washington, consumption data are from the USDOE EIA downloaded from
http://www.eia.doe.gov/oil_gas/natural_gas/applications/eia176query.html are are follows:
(See "EIA_NG_Data" worksheet in this workbook for raw EIA data)

	Sales (Million Cubic Feet of Natural Gas)			
	Residential	Commercial	Industrial	Total
2005	73,626	44,155	10,565	128,347
Fraction of 2005 Total	57%	34%	8%	100%

Note 3:

Based on results from Table 5.8 of the 2002 Energy Consumptions by Manufacturers--Data Tables published by the US Department of Energy's Energy Information Administration, and available as http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/pdf/table5.8_02.pdf, approximately 18% of industrial electricity use in the West Census region is used for HVAC, lighting, and "other facility support", with 6.7% of natural gas used for HVAC and "other facility support".
Thus, based on the figures above, industrial use of electricity for non-process uses in Washington may be roughly 14.3% of the total, and industrial use of gas for non-process use may be roughly 1.6% of total Commercial electricity and gas use, respectively. These figures are used as initial rules of thumb in estimating the contribution of savings from this policy from industrial sector measures.

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

RCI-5 **Rate Structures and Technologies to Promote Reduced GHG Emissions**

Date Last Modified: *11/9/2007 D. Von Hippel/Michael Lazarus*

Key Data and Assumptions	2012	2020/all	Units
The following calculation estimates GHG emissions reductions from two elements of RCI-5, inverted block tariff structures, and introduction of "smart meters" for electricity consumers. Other elements of RCI-5 provide GHG emissions reductions largely through supporting other policies in the RCI and Energy Supply sectors.			
First Year Results Accrue		2010	
Savings from Smart Meters and related rate structures for Residential Consumers			
Reduction in Residential Electricity Use		8%	
A review of smart metering-related studies and pilot installations (Smart meters: commercial, regulatory and policy drivers, by Gill Owen and Judith Ward of Sustainability First, dated March 2006, Appendicies document "Appendix 2 – Smart metering experience and studies", p. 19 to 34 in document available as http://www.sustainabilityfirst.org.uk/docs/smartmeterspdfappendices.pdf) suggests potential savings in a range of about 8 to 12 percent of consumption. Further input on this assumption is sought from the TWG			
Cost of Smart Meters per Meter		$200	
Assumed Cost of Implementation of Tariffs for Smart Meters and of Inverted Block Rate Structures		$0	$/MWh
In practice, there are likely to be some costs associated with smart meter tariff structures, including program costs, changes to billing systems, and possibly (in some cases) changes to metering or meter-reading systems. These costs are not explicitly accounted for in this analysis, but are likely to be quite small relative to the electricity cost savings achieved through the policy.			
Savings from Inverted Block Rates for Residential Consumers			
Reduction in Residential Electricity Use		4%	
Based on estimate from THE NEW MOTHER LODE: The Potential for More Efficient Electricity Use in the Southwest prepared by the Southwest Energy Efficiency Project (SWEEP), November, 2002, http://www.swenergy.org/nml/New_Mother_Lode.pdf. The estimate is based on a simple econometric calculation, assuming a three-block tariff, with the highest block having a tariff 50 percent higher than the average tariff for households, and the lowest block having a tariff half of the average tariff, so that the overall tariff structure was revenue-neutral. Based on empirical studies of the price elasticity of demand for electricity, the authors of the SWEEP study estimate an average savings of about 4% of residential as of 2000.			
Fraction of Residential Consumers to Whom Inverted Block Rates are Applied		35.00%	
Placeholder Assumption, but takes into account that somewhat under 60 percent of Washington's residential electricity consumers are served by utilities that currently have strongly-tiered inverted block rate structures. (Information on utility rate structures as of 2003 received from Stacy Waterman-Hoey of CTED.)			
Avoided Electricity Cost (Residential)		$64	$/MWh
See "Common Factors" worksheet in this workbook.			
Target Number of Smart Meters Installed Under Pilot Program		1.00%	
of Residential consumers, or		28,303	
consumers as of 2010.			
End Date of Pilot Program and End of Phase-in of Inverted Block Rates		2012	
Target Fraction Additional Residential Consumers Using Smart Meters, Full Program		0%	
Placeholder Assumption--no provision for full program currently in option description.			
Start Date of Full Program		2012	
Full Phase-in Date of Full Program		2020	

Other Data, Assumptions, Calculations	2012	2020/all	Units
Residential Electricity Sales	**35,408**	**38,095**	**GWh**
Residential Customers	**2,904,017**	**3,200,267**	
2005 customer number based on DOE EIA data. Assumes, until a separate projection of customer numbers is available, that growth in number of residential electricity customers will track growth in WA population.			
Implied Consumption per Customer	**12.19**	**11.90**	**MWh**
Cumulative Number of Installed Meters Under Pilot Program	**9,434**	**28,303**	
Cumulative Number of Installed Meters Under Full Program	**-**	**-**	
Cumulative Number of Consumers for Whom Inverted Block Rates Apply Under Program	**330,198**	**1,120,093**	
Factors for Annualizing Capital Costs (Residential Smart Meters)			
Interest Rate (real)		7%	/yr
Economic Life of Meter *(Rough estimate)*		15	years
Implied Annualization Factor		$0.11	%/yr
Implied Annualized Cost of Meters		$ 21.96	/meter-yr
Intermediate Cost Results, Pilot Smart Meter Program			
Total up-front meter costs for meters installed in each year	**$ 1,887**	**$ -**	thousand
Annualized Meter Costs	**$ 207**	**$ 621**	thousand
Intermediate Cost Results, Full Smart Meter Program			
Total up-front meter costs for meters installed in each year	**$ -**	**$ -**	thousand
Annualized Meter Costs	**$ -**	**$ -**	thousand

Results	2012	2020	Units
Electricity			
TOTAL Reduction in Electricity Sales, Pilot Smart Meter Program	28	27	GWh (sales)
Reduction in Generation Requirements, Pilot Smart Meter Program	30	29	GWh (generation)
TOTAL Reduction in Electricity Sales, Full Smart Meter Program	0	0	GWh (sales)
Reduction in Generation Requirements, Full Smart Meter Program	0	0	GWh (generation)
TOTAL Reduction in Electricity Sales, Inverted Block Tariff Program	496	533	GWh (sales)
Reduction in Generation Requirements, Inverted Block Tariff Program	534	574	GWh (generation)
Totals for Pilot Smart Meter Program			
Total Net GHG Emission Savings, Pilot Program	**0.01**	**0.01**	$MMtCO_2e$
Net Present Value (2008-2020), Pilot Program		**-$8**	$million
Cumulative Emissions Reductions (2008-2020), Pilot Program		0.1	$MMtCO_2e$
Cost-Effectiveness, Pilot Program		**-$52**	$/tCO_2e$
Totals for Full Smart Meter Program			
Total Net GHG Emission Savings, Full Program	**0.00**	**0.00**	$MMtCO_2e$
Net Present Value (2008-2020), Full Program		**$0**	$million
Cumulative Emissions Reductions (2008-2020), Full Program		0.0	$MMtCO_2e$
Cost-Effectiveness, Full Program		**#DIV/0!**	$/tCO_2e$
Totals for Inverted Block Rates Program			
Total Net GHG Emission Savings	**0.09**	**0.29**	$MMtCO_2e$
Net Present Value (2008-2020)		**-$219**	$million
Cumulative Emissions Reductions (2008-2020), Full Program		2.8	$MMtCO_2e$
Cost-Effectiveness		**-$79**	$/tCO_2e$
Totals for Policy (Pilot plus Full Smart Meter Programs, plus Inverted Block Program)			
Total Net GHG Emission Savings	**0.09**	**0.30**	$MMtCO_2e$
Net Present Value (2008-2020)		**-$226**	$million
Cumulative Emissions Reductions (2008-2020)		2.9	$MMtCO_2e$
Cost-Effectiveness		**-$78**	$/tCO_2e$

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

RCI-10 **More Stringent Appliance/Equipment/ Lighting Efficiency Standards, and Appliance and Lighting Product Recycling and Design**

Date Last Modified:	*11/9/2007*	*D. Von Hippel/C. Lee*

Key Data and Assumptions	2012	2020/all	Units
First Year Results Accrue		**2010**	
Avoided Electricity Cost		**$64**	$/MWh
See "Common Factors" worksheet in this workbook.			
Avoided Natural Gas Cost		**$6.8**	$/MMBtu
See "NG prices aeo2006" and "Common Factors" worksheets in this workbook.			

Data and Assumptions: Appliance and Equipment Energy Efficiency Standards (excluding Televisions)

Projected Energy Savings from 15 Proposed Standards (in 2020)

The data below are drawn from ASAP and ACEEE, 2006. "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", http://www.standardsasap.org/stateops.htm and http://www.standardsasap.org/a062_wa.pdf, and represent cost and savings for a package of appliance and equipment improvements, as estimated by the authors, for Washington State. See Note 1, below, for a printout of the full Table from which these data have been extracted.

Standards that Save Electricity (data from ASAP/ACEEE source above)

Products	Annual Savings/yr-unit (kWh)	Incremental Cost/unit	Annual savings from one year's sales (GWh)	Energy Savings through 2020 (GWh)
Bottle-type Water Dispensers	266	12	0.7	5.5
Commercial Hot Food Holding Cabinets	1815	453	0.6	7.8
Compact Audio Products	53	1	7.5	37.4
DVD Players and Recorders	11	1	1.1	5.4
Liquid-immersed Distribution Transformers	6	2	14.2	177
Medium-voltage Dry-type Dist. Transform.	6/kVA	2/kVA	0.9	10.9
Metal Halide Lamp Fixtures	307	30	15	188.1
Portable Electric Spa (Hot Tubs)	250	100	0.5	5.1
Residential Furnaces and Res. Boilers	401	100	19.4	164.7
Single-voltage ext. AC->DC Power Supplies	4	0.5	15.1	105.8
State-regulated Incandescent Refl. Lamps	61	1	128.5	120.8
Walk-in Refrigerators and Freezers	8220	957	11.2	133.9
TOTAL OF ABOVE			214.7	962.4

Standards that Save Electricity (results derived from above)

Products	Implied Lifetime (years)	Number of Units/yr	Implied Levelized Cost per Unit ($/yr)	Implied Levelized Cost/MWh saved
Bottle-type Water Dispensers	7.86	2,632	$2.04	$7.66
Commercial Hot Food Holding Cabinets	13.00	331	$54.20	$29.86
Compact Audio Products	4.99	141,509	$0.24	$4.61
DVD Players and Recorders	4.91	100,000	$0.25	$22.52
Liquid-immersed Distribution Transformers	12.46	2,366,667	$0.25	$40.95
Medium-voltage Dry-type Dist. Transform.	12.11	150,000	$0.25	$41.72
Metal Halide Lamp Fixtures	12.54	48,860	$3.67	$11.96
Portable Electric Spa (Hot Tubs)	10.20	2,000	$14.04	$56.17
Residential Furnaces and Res. Boilers	8.49	48,379	$16.02	$39.95
Single-voltage ext. AC->DC Power Supplies	7.01	3,775,000	$0.09	$23.18
State-regulated Incandescent Refl. Lamps	0.94	2,106,557	$1.14	$18.62
Walk-in Refrigerators and Freezers	11.96	1,363	$120.78	$14.69

Costs Levelized using an assumed real interest rate of 7% per year.

Standards that Save Natural Gas (data from ASAP/ACEEE source above)

Products	Annual Savings/yr-unit (therms)	Incremental Cost/unit	Annual savings from one year's sales (Million CF)	Energy Savings through 2020 (Million CF)
Commercial Boilers	121	2968	15	127.8
Pool Heaters	58	295	21	178.5
Residential Furnaces and Res. Boilers	56	373	166.3	1430.4

Standards that Save Natural Gas (results derived from above)

Products	Implied Lifetime (years)	Number of Units/yr	Implied Levelized Cost per Unit ($/yr)	Implied Levelized Cost/MMBtu saved
Commercial Boilers	8.52	1,277	$474.22	$39.19
Pool Heaters	8.50	3,729	$47.22	$8.14
Residential Furnaces and Res. Boilers	8.60	30,587	$59.18	$10.57

Appliances/Equipment Already Included in Washington "Recent Actions" Accounting and Overlapping with Electricity-saving devices Above (no gas devices overlap with above)

Products		Annual savings from one year's sales (GWh)
Commercial refrigerators/freezers		3.68
Reflector lamps		41.17
External power supplies		14.02

Above drawn from CCS accounting of Washington "Recent Actions", as described in workbook "Recent Actions in Work.xls", as of July, 2007. Original data on annual savings from analysis of HB 1062 State Energy Efficiency Standards by Liz Klumpp of WA CTED, file "Summary 1062 prod standards 5-05.doc".

Fraction of devices above purchased in WA covered by program: 100%
Assumption based on initiation of standards.

	2012	2020/all	Units

Data and Assumptions: Television Energy Efficiency Standards

Target Improvement in Television Energy Efficiency: 25%
*RCI-10 Target. This is somewhat below the savings included in an "improved case" for TV efficiency as modeled by Ecos Consulting for the Natural Resources Defense Council (NRDC, see **Note 2**), which includes a reduction of about 25 percent in active mode power consumption, combined with the the EPA's Energy Star "Tier 3" guideline of less than 1 watt per unit standby power consumption.*

Fraction of new TVs purchased in WA covered by program: 100%
Assumption based on initiation of standards.

	2020/all	Units
Estimated Number of TVs in the US as of 2004 (from source in ***Note 2***)	266	million
Number of TVs added nationally per year (from source in ***Note 2***)	3.5	million
Average lifetime of TV (estimated from source in ***Note 2***)	8	years
National electricity consumption by TVs as of 2006 (estimated from source in ***Note 2***)	52	TWh

Levelized cost of more efficient TVs per unit energy saved: $ 20.00 /MWh
Placeholder assumption, but consistent, for example, with incremental costs for higher-efficiency DVD players and recorders, above.

Data and Assumptions: Lighting Efficiency Standards	2012	2020/all	Units
Target Improvement in Residential Lighting Energy Efficiency		50%	
Target Improvement in Commercial Lighting Energy Efficiency		25%	
RCI-10 Target.			
Fraction of lighting purchased in WA covered by program		100%	
Assumption based on initiation of standards.			
Fraction of Residential Electricity Consumption as Lighting		8.8%	
National average based on Residential Energy Consumption Survey data from 2001 survey (http://www.eia.doe.gov/emeu/recs/recs2001/enduse2001/enduse2001.html).			
Fraction of Commercial Electricity Consumption as Lighting		23.1%	
National average based on Commercial Building Energy Consumption Survey data from 1999 (http://www.eia.doe.gov/emeu/cbecs/enduse_consumption/intro.html).			
Levelized cost of Residential Lighting Improvements		$ 31.00	/MWh
Rough average of Retrofit and New Lighting measures from source in ***Note 3*** *.*			
Levelized cost of Commercial Lighting Improvements		$ 27.00	/MWh
From source in ***Note 3*** *.*			
Weighted-average lifetime of Lighting Equipment			
Residential Sector		3	years
Commercial Sector		6	years
Rough estimates, used to calculate retrofit market for lighting improvements			

Other Data, Assumptions, Calculations	2012	2020/all	Units

Calculations: Appliance and Equipment Energy Efficiency Standards (excluding Televisions)

	2012	2020/all	Units
Fraction of devices purchased in Washington covered by RCI-10	100%	100%	

Annual First-year Energy Savings From

Products	2012	2020/all	Units
Bottle-type Water Dispensers	0.8	0.9	GWh
Commercial Hot Food Holding Cabinets	0.7	0.8	GWh
Compact Audio Products	8.6	9.8	GWh
DVD Players and Recorders	1.3	1.4	GWh
Liquid-immersed Distribution Transformers	16.0	18.5	GWh
Medium-voltage Dry-type Dist. Transform.	1.0	1.2	GWh
Metal Halide Lamp Fixtures	16.9	19.5	GWh
Portable Electric Spa (Hot Tubs)	0.6	0.7	GWh
Residential Furnaces and Res. Boilers	22.3	25.4	GWh
Single-voltage ext. AC->DC Power Supplies **(excl. recent actions)**	3.3	5.8	GWh
State-regulated Incandescent Refl. Lamps **(excl. recent actions)**	103.5	126.2	GWh
Walk-in Refrigerators and Freezers **(excl. recent actions)**	8.9	10.9	GWh
Commercial Boilers	16.0	17.4	Billion Btu
Pool Heaters	23.8	25.8	Billion Btu
Residential Furnaces and Res. Boilers	188.6	204.0	Billion Btu

Cumulative Energy Savings From

Products	2012	2020/all	Units
Bottle-type Water Dispensers	2.4	7.7	GWh
Commercial Hot Food Holding Cabinets	2.0	7.9	GWh
Compact Audio Products	25.4	56.0	GWh
DVD Players and Recorders	3.7	8.2	GWh
Liquid-immersed Distribution Transformers	46.9	186.7	GWh
Medium-voltage Dry-type Dist. Transform.	3.0	11.8	GWh
Metal Halide Lamp Fixtures	49.6	197.2	GWh
Portable Electric Spa (Hot Tubs)	1.7	6.7	GWh
Residential Furnaces and Res. Boilers	65.6	214.3	GWh
Single-voltage ext. AC->DC Power Supplies **(excl. recent actions)**	9.0	37.0	GWh
State-regulated Incandescent Refl. Lamps **(excl. recent actions)**	200.9	223.6	GWh
Walk-in Refrigerators and Freezers **(excl. recent actions)**	26.0	106.8	GWh
Commercial Boilers	47.3	167.2	Billion Btu
Pool Heaters	70.5	247.1	Billion Btu
Residential Furnaces and Res. Boilers	558.4	1,957.1	Billion Btu

Cost of Energy Savings From	**2012**	**2020/all**	**Units**
Products			
Bottle-type Water Dispensers	**$ 18**	**$ 59**	$ thousand
Commercial Hot Food Holding Cabinets	**$ 59**	**$ 236**	$ thousand
Compact Audio Products	**$ 117**	**$ 258**	$ thousand
DVD Players and Recorders	**$ 84**	**$ 185**	$ thousand
Liquid-immersed Distribution Transformers	**$ 1,923**	**$ 7,646**	$ thousand
Medium-voltage Dry-type Dist. Transform.	**$ 124**	**$ 494**	$ thousand
Metal Halide Lamp Fixtures	**$ 593**	**$ 2,359**	$ thousand
Portable Electric Spa (Hot Tubs)	**$ 95**	**$ 374**	$ thousand
Residential Furnaces and Res. Boilers	**$ 2,620**	**$ 8,560**	$ thousand
Single-voltage ext. AC->DC Power Supplies **(excl. recent actions)**	**$ 208**	**$ 857**	$ thousand
State-regulated Incandescent Refl. Lamps **(excl. recent actions)**	**$ 3,741**	**$ 4,164**	$ thousand
Walk-in Refrigerators and Freezers **(excl. recent actions)**	**$ 382**	**$ 1,569**	$ thousand
Commercial Boilers	**$ 1,854**	**$ 6,554**	$ thousand
Pool Heaters	**$ 574**	**$ 2,012**	$ thousand
Residential Furnaces and Res. Boilers	**$ 5,901**	**$ 20,683**	$ thousand

Calculations: Television Energy Efficiency Standards

Implied consumption of electricity per TV set as of 2006		190	kWh
Number of new televisions purchased per captia in the US as of 2006		0.1257	
Number of new televisions purchased in Washington	856,060	943,390	
Fraction of Televisions purchased in Washington covered by RCI-10	100%	100%	
First-year Electricity Savings from TV Standards Element of RCI-10	40.8	44.9	GWh
Cumulative Electricity Savings from TV Standards Element of RCI-10	120.7	384.6	GWh
Cumulative Cost of Purchasing More Efficient TVs	**$ 2,415**	**$ 9,313**	$ thousand

Calculations: Lighting Efficiency Standards

Fraction of Lighting Purchases in Washington covered by RCI-10	100%	100%	
Implied consumption of electricity for Lighting, Residential	3,441	3,931	GWh
Implied consumption of electricity for Lighting, Commercial	7,453	8,621	GWh
Applies national average fractions above to forecast electricity use in Washington.			
Implied electricity used in new and retrofit Lighting, Residential	1,063	1,059	GWh
Implied electricity used in new and retrofit Lighting, Commercial	1,264	1,240	GWh
Implied new and retrofit Lighting covered under RCI-10, Residential	1,063	1,059	GWh
Implied new and retrofit Lighting covered under RCI-10, Commercial	1,264	1,240	GWh
Implied savings of electricity for Lighting standards, Residential	1,603	2,127	GWh
Implied savings of electricity for Lighting standards, Commercial	940	2,172	GWh
Cumulative Cost of Purchasing More Efficient Lighting, Residential	**$ 49,700**	**$ 65,946**	$ thousand
Cumulative Cost of Purchasing More Efficient Lighting, Commercial	**$ 25,385**	**$ 58,643**	$ thousand

Results	2012	2020	Units
Electricity Savings from Appliance/Equipment Standards (Excluding TVs)			
Reduction in Electricity Sales: Residential	105	322	GWh (sales)
Reduction in Electricity Sales: Commercial	331	742	GWh (sales)
TOTAL Reduction in Electricity Sales	436	1,064	GWh (sales)
Reduction in Generation Requirements	470	1,144	GWh (generation)
GHG Emission Savings	**0.24**	**0.57**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$191**	$million
Cumulative Emissions Reductions (2008-2020)		4.0	$MMtCO_2e$
Cost-Effectiveness		**-$47.71**	$\$/tCO_2e$
Gas Savings from Appliance/Equipment Standards			
Reduction in Gas Sales: Residential	629	2,204	Billion Btu
Reduction in Gas Sales: Commercial	47	167	Billion Btu
TOTAL Reduction in Gas Sales	676	2,372	Billion Btu
GHG Emission Savings	**0.04**	**0.13**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**$53**	$million
Cumulative Emissions Reductions (2008-2020)		0.8	$MMtCO_2e$
Cost-Effectiveness		**$65.87**	$\$/tCO_2e$
Electricity Savings from Television Standards			
Reduction in Electricity Sales: Residential	121	385	GWh (sales)
Reduction in Electricity Sales: Commercial	0	0	GWh (sales)
TOTAL Reduction in Electricity Sales	121	385	GWh (sales)
Reduction in Generation Requirements	130	414	GWh (generation)
GHG Emission Savings	**0.07**	**0.21**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$72**	$million
Cumulative Emissions Reductions (2008-2020)		1.4	$MMtCO_2e$
Cost-Effectiveness		**-$51.01**	$\$/tCO_2e$
Electricity Savings from Lighting Standards			
Reduction in Electricity Sales: Residential	1,603	2,127	GWh (sales)
Reduction in Electricity Sales: Commercial	940	2,172	GWh (sales)
TOTAL Reduction in Electricity Sales	2,543	4,299	GWh (sales)
Reduction in Generation Requirements	2,742	4,624	GWh (generation)
GHG Emission Savings	**1.37**	**2.31**	$MMtCO_2e$
Economic Analysis			
Net Present Value (2008-2020)		**-$864**	$million
Cumulative Emissions Reductions (2008-2020)		20.3	$MMtCO_2e$
Cost-Effectiveness		**-$42.48**	$\$/tCO_2e$

Summary Results for RCI-10	2012	2020	Units
Total for Option (Natural gas and Electricity)			
GHG Emission Savings	**1.7**	**3.2**	$MMtCO_2e$
Net Present Value (2008-2020)		**-$1,075**	$million
Cumulative Emissions Reductions (2008-2020)		**26.6**	$MMtCO_2e$
Cost-Effectiveness		**-$40.46**	$\$/tCO_2e$

NOTES AND DATA FROM SOURCES

Note 1:

Table below from ASAP and ACEEE, 2006. "Leading the Way: Continued Opportunities for New State Appliance and Equipment Efficiency Standards", http://www.standardsasap.org/stateops.htm and http://www.standardsasap.org/a062_wa.pdf.

Energy Efficiency Standards Benefits -- 2006 Model Bill

Washington															
Summary of Benefits by Product				2020							2030				
								Emissions Reductions							
Products	Annual Savings per Unit	Incre-mental Cost per Unit	Annual Energy Savings from One Year's Sales	Energy Savings	Summer Peak Capacity Reduction	Direct and Indirect Natural Gas Savings[1]	Value of Bill Savings[2]	Carbon	NOx	SO2	Energy Savings	Summer Peak Capacity Reduction	Value of Bill Savings[2]	Pay Back Period	Net Present Value[3]
	kWh or [therms]	$	GWh [Million CF]	GWh [Million CF]	MW	Million CF	$Million	1000 MT	Metric Tons	Metric Tons	GWh [Million CF]	MW	$Million	Years	$Million (2005$)
Bottle-type water dispensers	266	12	0.7	5.5	0.8	28.0	0.3	1.1	1.6	4.5	5.5	0.8	0.3	0.7	2.9
Commercial boilers[4]	[121]	2,968	[15]	[127.8]	NA	127.8	1.3	1.9	2.7	0.0	[278.2]	NA	2.9	5.8	12.8
Commercial hot food holding cabinets	1,815	453	0.6	7.8	2.6	39.7	0.5	1.5	2.2	6.4	9.4	3.1	0.6	4.0	2.9
Compact audio products	53	1	7.5	37.4	5.2	189.3	2.4	7.3	10.7	30.3	37.4	5.2	2.4	0.3	23.2
DVD players and recorders	11	1	1.1	5.4	0.7	27.4	0.4	1.1	1.6	4.4	5.4	0.7	0.4	1.4	2.4
Liquid-immersed distribution transformers	6	2	14.2	177.0	24.4	896.7	11.0	34.6	50.8	143.5	318.7	44.0	19.8	6.6	91.0
Medium voltage dry-type distribution transformers	6/kVA	2/kVA	0.9	10.9	1.5	55.0	0.7	2.1	3.1	8.8	19.6	2.7	1.2	5.4	6.3
Metal halide lamp fixtures	307	30	15.0	188.1	61.6	952.8	11.7	36.8	53.9	152.4	301.0	98.5	18.7	1.6	120.1
Pool heaters[4]	[58]	295	[21]	[178.5]	NA	178.5	2.1	2.7	3.8	0.0	[315.1]	NA	3.7	4.5	12.8
Portable electric spas (hot tubs)	250	100	0.5	5.1	1.2	25.8	0.3	1.0	1.5	4.1	5.1	1.2	0.3	6.2	0.6
Residential furnaces and residential boilers[4,5]	401	100	19.4	164.7	4.0	2,264.8	27.5	54.0	77.5	133.6	348.9	8.5	58.3	3.8	181.8
	[56]	[373]	[166.3]	[1430.4]							[3030.1]			[6]	
Residential pool pumps	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Singe-voltage external AC to DC power supplies	4	0.5	15.1	105.8	14.6	536.0	6.9	20.7	30.3	85.8	105.8	14.6	6.9	1.8	46.3
State-regulated incandescent reflector lamps	61	1	128.5	120.8	29.8	611.8	7.5	23.6	34.6	97.9	120.8	29.8	7.5	0.2	66.5
Walk-in refrigerators and freezers	8,220	957	11.2	133.9	31.2	678.4	8.3	26.2	38.4	108.5	133.9	31.2	8.3	1.9	57.3
Total			**215**	**963**	**177**	**6,612**	**81**	**215**	**313**	**780**	**1,411**	**240**	**131**		**627**
[natural gas]			[202.3]	[1736.7]							[3623.3]				

Notes:

[1] Direct natural gas savings are savings from use of more efficient natural gas appliances. Indirect natural gas savings are reductions in natural gas at power plants due to use of more efficient electric appliances. Indirect gas savings assume that half the power saved at power plants would be generated with natural gas.

[2] Value of energy savings is based on energy savings and average state energy prices. This value does not take account of the incremental cost of more efficient products.

[3] Net present value is the total monetary value of bill savings achieved by products sold under the standards between now and 2030 minus the total incremental product cost incurred by purchasers as a result of the standards over the same period expressed in current dollars. Both costs and savings are discounted using a 5% real discount rate.

[4] Commercial boilers, pool heaters, and residential boilers and furnaces save natural gas. Gas savings are expressed in cubic feet and enclosed in brackets to distinguish from electricity savings.

[5] Residential furnaces and boilers include both natural gas and oil furnaces and boilers as well as furnace fans. Annual savings per unit, incremental cost per unit and pay back period shown here are just for gas furnaces and furnace fans, which are the most common of these products. For these calculations, gas furnace values are enclosed in brackets and listed below furnace fan values.

Note 2:

Information on energy efficiency improvements in televisions from <u>TELEVISIONS, Active Mode Energy Use and Opportunities for Energy Savings,</u> Project Manager and Editor, Noah Horowitz, Natural Resources Defense Council; Authors, Peter Ostendorp, Suzanne Foster, and Chris Calwell, Ecos Consulting. Natural Resources Defense Council Issue Paper, March 2005. Available as http://www.nrdc.org/air/energy/energyeff/tv.pdf.

The table that follows (from page 22 of the Issue Paper referenced above) show electricity consumption improvement for several types of TV models for the NRDC "Improved" case.

Table 7: Comparison of Baseline and Improved Cases for TV Energy Consumption

TV Type	Base Case Annual Energy Consumption (kWh per unit per year)	Improved Case[31] Annual Energy Consumption (kWh per unit per year)
Standard, small-screen TV	184	125
Standard, large-screen TV	312	221
ED/HD, small-screen TV	301	212
ED/HD, large-screen TV	455	328

Note 3:

ENERGY EFFICIENCY AND CONSERVATION MEASURE RESOURCE ASSESSMENT: Executive Summary of Results
Prepared for the Energy Trust of Oregon, Inc., Final Report, May 4, 2006. By Stellar Processes And Ecotope.
Available as http://www.energytrust.org/library/reports/060508_RA_Executive_summary.pdf.

Estimate of Mitigation Option Costs and Benefits for Washington RCI GHG Analysis

RCI-11 **Policies and/or Programs Specifically Targeting Non-energy GHG Emissions**

Date Last Modified:	*11/17/2007*	*D. Von Hippel/C. Lee*

Key Data and Assumptions	2012	2020/all	Units
First Year Results Accrue		2010	
Forecast WA CO_2 emissions from Cement Manufacture	0.489	0.535	$MMtCO_2e$
Forecast Total WA GHG emissions from Aluminum Manufacture	0.352	0.340	$MMtCO_2e$
Fraction of Aluminum Manufacturing GHG emissions from CO_2	65%	70%	
Assumption. Data from last several years of WA GHG inventory (2000 - 2004) show CO_2 emissions as a share of total Aluminum-sector emissions increasing, as emissions of CF_4 and C_2F_6 decrease, but as future emissions are forecast based on projected growth of employment in the primary metals sector, this trend does not appear to have been extended in the reference forecast. We assume that by 2020 additional phase-out of the fluorinated gases will modestly increase the fraction of GHG emissions made up of carbon dioxide relative to 2004.			
Carbon Dioxide Emissions from Aluminum Manufacturing	0.228	0.238	$MMtCO_2e$
Year 2020 CO_2 savings target for Cement Manufacturing (% of reference case emissions)		10%	
As included in RCI-11 "goals" text.			
Credit for reduction in CO_2 emissions from fuel consumption reductions due to measures to reduce non-energy cement industry CO_2 emissions (multiplier):		1.79	
Based on a comparison of the ratio of fuel use emissions to calcination emissions at two Seattle-area cement production facilities as prepared by Michael Lazarus of SEI-US/CCS.			
Fractional Emissions Savings by Year, CO_2 from Cement	2.7%	10.0%	
Year 2020 CO_2 savings target for Aluminum Manufacturing (% of reference case emissions)		0%	
Set at zero pending receipt of information on potential savings and costs of emissions reduction options. See ***Note 4****.*			
Fractional Emissions Savings by Year, CO_2 from Aluminum	0.0%	0.0%	
Forecast WA HFC emissions from Refrigeration and other uses (ODS Substitutes)	3.357	5.119	$MMtCO_2e$
Year 2020 CO_2e savings target for ODS substitutes (% of reference case emissions)		25%	
Source in ***Note 1*** *provides a scenario wherein approximately 25 percent emissions of ODS substitutes used for refrigeration and air conditioning in California are avoided through a variety of measures (see* ***Note 2****).*			
Fractional Emissions Savings by Year, CO_2e from ODS substitutes	6.8%	25.0%	
Forecast WA SF_6 emissions from the Electric Utility Sector	0.178	0.124	$MMtCO_2e$
Year 2020 CO_2e savings target for SF_6 from Electric Utility Sector (% of reference case emissions)		80%	
Source in ***Note 1*** *suggests that 100% reduction is possible. A lower value has been selectedhere as probably more feasible, pending input from the TWG.*			
Fractional Emissions Savings by Year, CO_2e from Electric Utility SF_6 use.	21.8%	80.0%	
Costs of GHG Emissions Reductions			
Cost of Savings from reduction of CO_2 Emissions from Cement Manufacturing	$ (8.68)	$ (8.68)	$\$/tCO_2e$
Derived from analysis done for the California Energy Commission. See ***Note 3****.*			
Cost of Savings from reduction of CO_2 Emissions Aluminum Manufacturing	$ 12.00	$ 15.00	$\$/tCO_2e$
Placeholder value.			
Cost of Savings from Reduced Use/Emissions of ODS Substitutes	$ 1.64	$ 1.64	$\$/tCO_2e$
Derived from analysis done for the California Energy Commission. See ***Note 2****.*			
Cost of Savings from SF_6 Emissions Reduction in Electric Utility Industry	$ 3.38	$ 3.38	$\$/tCO_2e$
Estimated using sources and data shown in ***Note 1****.*			

Results	2012	2020	Units
GHG Emissions Reductions from Programs Targeting Non-energy GHG Emissions			
Savings from reduction of CO_2 Emissions from Cement Manufacturing	0.024	0.096	$MMtCO_2e$
Savings from reduction of CO_2 Emissions Aluminum Manufacturing	0.000	0.000	$MMtCO_2e$
Savings from Reduced Use/Emissions of ODS Substitutes	0.229	1.280	$MMtCO_2e$
Savings from SF_6 Emissions Reduction in Electric Utility Industry	0.039	0.099	$MMtCO_2e$
TOTAL of Above	**0.292**	**1.475**	$MMtCO_2e$
Economic Analysis: Emissions Reduction from Cement Manufacturing			
Net Present Value (2008-2020)		**-$3**	$million
Cumulative Emissions Reductions (2008-2020)		0.6	$MMtCO_2e$
Cost-Effectiveness		**-$5.44**	$/tCO_2e$
Economic Analysis: Emissions Reduction from Aluminium Manufacturing			
Net Present Value (2008-2020)		**$0**	$million
Cumulative Emissions Reductions (2008-2020)		0.0	$MMtCO_2e$
Cost-Effectiveness		**N/A**	$/tCO_2e$
Economic Analysis: Emissions Reduction from Reduce Use/Emissions of ODS Substitutes			
Net Present Value (2008-2020)		**$7**	$million
Cumulative Emissions Reductions (2008-2020)		6.5	$MMtCO_2e$
Cost-Effectiveness		**$1.01**	$/tCO_2e$
Economic Analysis: Reduction of SF_6 Emissions in Electric Utility Industry			
Net Present Value (2008-2020)		**$1**	$million
Cumulative Emissions Reductions (2008-2020)		0.7	$MMtCO_2e$
Cost-Effectiveness		**$2.16**	$/tCO_2e$

Summary Results for RCI-11	2012	2020	Units
Total for Option (Natural gas and Electricity)			
GHG Emission Savings	**0.3**	**1.5**	$MMtCO_2e$
Net Present Value (2008-2020)		**$5**	$million
Cumulative Emissions Reductions (2008-2020)		**7.8**	$MMtCO_2e$
Cost-Effectiveness		**$0.65**	$/tCO_2e$

NOTES AND DATA FROM SOURCES

Note 1:

EMISSION REDUCTION OPPORTUNITIES FOR NON-CO2 GREENHOUSE GASES IN CALIFORNIA. Prepared for the California Energy Commission (CEC) Public Interest Energy Research Program by: ICF Consulting, and dated July 2005 (report # CEC-500-2005-121). This report, quoting the European Union document Economic Evaluation of Sectoral Emission Reduction Objectives for Climate Change: Economic Evaluation of Emission Reduction of Greenhouse Gases in the Energy Supply Sector in the EU Bottom-up Analysis, Final Report, March 2001, (and its summary volumes), available as http://ec.europa.eu/environment/enveco/climate_change/pdf/energy_supply.pdf, cites a potential savings of SF_6 emissions from electric utilities operations of 100% using equipment for capturing and recycling the gas during maintenance operations on electrical equipment. The CEC report lists capital costs for the measure of 10.96 year 2000 dollars per annual tonne CO_2 equivalent saved, plus annual costs of 1.81 $/te saved. The EU source document lists a lifetime of 15 years. Using a real interest rate of 7% /yr implies a capital recovery factor of 10.98% annually, and converting into year 2005 dollars, and adding in annual costs yields a cost of $ 3.38 year 2005 dollars per tonne CO_2 equivalent saved.

For this analysis, we assume that the achievable savings is less than the 100% indicated in the CEC report.

Note 2:

The data that follow on reductions of GHG emissions from ODS substitutes are from the CEC report described in Note 1, page 65 (table 48).

Total estimated emissions from this source in California in 2020 are 24.38 $MMtCO_2e$ (from Table 45).

Option	Break-Even Price ($/MTCO$_2$ Eq.) ($2000)	Incremental Reductions MMtCO$_2$e
Improved HFC-134a in MVACs	$ (133.56)	0.07
HFC-152a in MVACs	$ (37.64)	0.3
CO2 for New MVACs	$ (33.51)	0.34
Replace DX with Distributed System	$ (6.58)	1.79
Leak Repair	$ (3.78)	0.37
Recovery (REFRIG)	$ 4.94	0.44
Secondary Loop	$ 13.97	1.9
Ammonia Secondary Loop	$ 25.33	1.01
Weighted Average/Total	$ 1.46	6.22
Weighted Average Cost in $2005)	$ 1.64	

Note 3:

The presentation "Policy Options for Reducing CO_2 Emissions from CA Cement", by Ned Helme and David Wagger, Center for Clean Air Policy, prepared for the California Energy Commission Climate Change Advisory Committee, and dated April 6, 2005 (available as http://www.energy.ca.gov/global_climate_change/04-CCAC-1_advisory_committee/documents/2005-04-06_meeting/2005-04-06_HELME_WAGGER.PDF) suggests that the two measures below can save reduce California's cement industry CO_2 emissions by about 10 percent, at the costs shown.
(Year of cost figures not provided in source, and is assumed to be approximately 2005.)

Option	MMTCO$_2$	$/MTCO$_2$
Limestone Portland Cement	12.6	$ (21.00)
Blended Cement	14	$ 2.40
Total/Weighted Average	26.6	$ (8.68)

Note 4:

The Aluminum Association Climate VISION Work Plan (http://www.climatevision.gov/sectors/aluminum/pdfs/workplan.pdf) includes the following passage describing potential improvements that would yield reduced direct emissions of carbon dioxide from the aluminum production process.

> "Options to reduce direct CO_2 emissions from the carbon anode Hall-Heroult process include improvements in chemical bath management and process controls to reposition the anodes. As a result, the anode-cathode gap can be optimized reducing electrical resistance and energy consumption as well as reducing anode carbon consumption rates. These improvements achieve efficiency gains in aluminum output per unit of carbon anode consumed, thereby reducing CO_2 emissions per unit of production and per unit of energy consumed."

Specific information, however, has not yet been identified on the potential savings and costs of these improvements.
As a result, savings in direct CO_2 emissions from the aluminum sector are set at zero at present.